US009173550B2

(12) **United States Patent**
Murakami

(10) **Patent No.: US 9,173,550 B2**
(45) **Date of Patent: Nov. 3, 2015**

(54) **MEDICAL APPARATUS**

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(73) Assignee: **OLYMPUS CORPORATION**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1006 days.

(21) Appl. No.: **12/057,990**

(22) Filed: **Mar. 28, 2008**

(65) **Prior Publication Data**

US 2009/0030273 A1 Jan. 29, 2009

Related U.S. Application Data

(63) Continuation-in-part of application No. 12/035,535, filed on Feb. 22, 2008, which is a continuation-in-part of application No. 11/809,488, filed on Jun. 1, 2007, now Pat. No. 8,021,293, which is a continuation-in-part of application No. 11/652,880, filed on Jan. 12, 2007, now Pat. No. 8,444,547, which is a continuation-in-part of application No. 11/435,183, filed on May 16, 2006, now Pat. No. 8,617,054, which is a continuation-in-part of application No. 11/331,963, filed on Jan. 13, 2006, now Pat. No. 8,092,371.

(51) **Int. Cl.**
A61B 17/00 (2006.01)
A61B 1/00 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***A61B 1/0052*** (2013.01); ***A61B 1/0055*** (2013.01); ***A61B 1/018*** (2013.01); ***A61B 17/29*** (2013.01); ***A61B 19/081*** (2013.01); ***A61B 19/22*** (2013.01); *A61B 17/00234* (2013.01); *A61B 2017/00278* (2013.01); *A61B 2017/2905* (2013.01); *A61B 2017/2906* (2013.01); *A61B 2017/2908* (2013.01); *A61B 2017/2927* (2013.01); *A61B 2019/2219* (2013.01); *A61B 2019/2242* (2013.01); *A61B 2019/2269* (2013.01); *A61B 2019/4868* (2013.01)

(58) **Field of Classification Search**
USPC 600/104, 106, 107, 123, 131, 114, 115, 600/139–154, 127, 129; 604/528; 606/1, 606/205–209
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,245,624 A 1/1981 Komiya
4,577,621 A 3/1986 Patel
(Continued)

FOREIGN PATENT DOCUMENTS

CN 1602166 A 3/2005
CN 1886087 A 12/2006
(Continued)

OTHER PUBLICATIONS

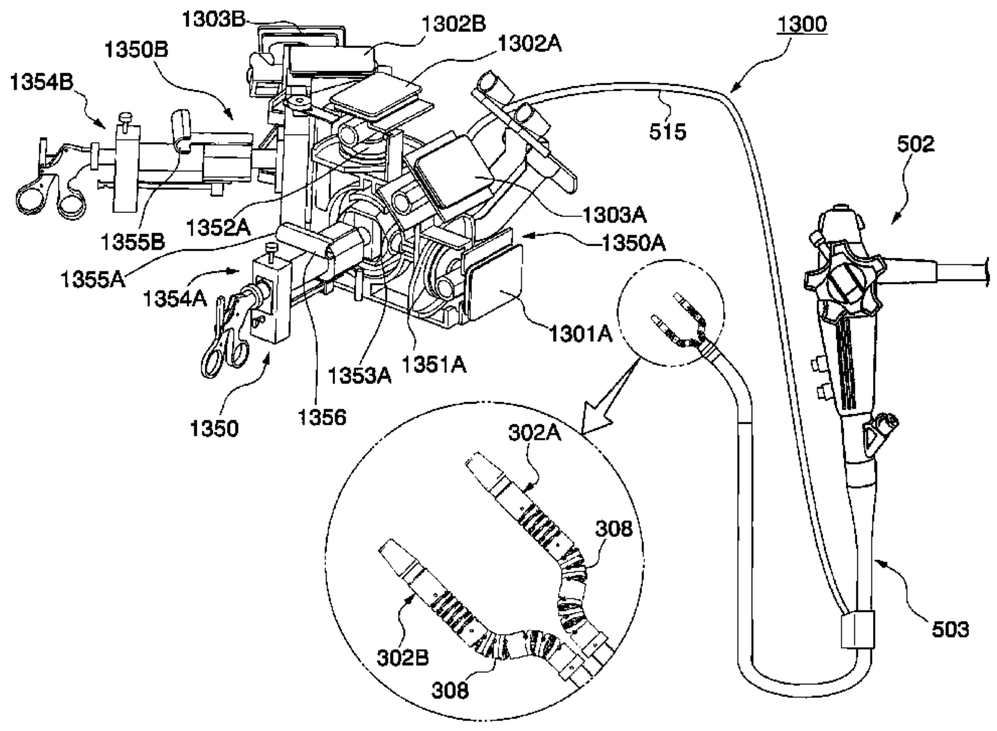
U.S. Office Action dated Feb. 1, 2011 received in related U.S. Appl. No. 11/809,488.
(Continued)

Primary Examiner — Ryan Henderson
(74) *Attorney, Agent, or Firm* — Scully, Scott, Murphy & Presser, P.C.

(57) **ABSTRACT**

A medical apparatus according to the present invention includes: a flexible sheath; an arm section having a bending part capable of bending operation and a first channel capable of inserting a procedure instrument therethrough, the arm section being disposed to protrude from a tip of the sheath; and an operation stick having a second channel connected to the first channel and a bending operating part connected to the arm section by an operation-transmission member, wherein the operation stick has: a regulation section for regulating movement of the bending operating part; and a falloff-preventive section for engaging with the procedure instrument inserted in the second channel to prevent the procedure instrument from falling from the operation stick.

18 Claims, 52 Drawing Sheets



(51) **Int. Cl.**

A61B 1/04	(2006.01)
A61M 25/00	(2006.01)
A61B 1/005	(2006.01)
A61B 1/018	(2006.01)
A61B 17/29	(2006.01)
A61B 19/08	(2006.01)
A61B 19/00	(2006.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,873,965	A	10/1989	Danieli	
5,173,716	A	12/1992	Tetsuka	43/903
5,217,114	A	6/1993	Gadberry et al.	
5,299,559	A	4/1994	Bruce et al.	600/141
5,318,013	A	6/1994	Wilk	
5,395,367	A	3/1995	Wilk	
5,448,989	A	9/1995	Heckele	
5,683,349	A	11/1997	Makower et al.	
5,855,569	A	1/1999	Komi	604/526
5,916,147	A	6/1999	Boury	
5,976,075	A	11/1999	Beane et al.	
6,013,024	A	1/2000	Mitsuda et al.	
6,352,503	B1	3/2002	Matsui et al.	
6,780,151	B2	8/2004	Grabover et al.	
7,833,156	B2	11/2010	Williams et al.	
2002/0087048	A1	7/2002	Brock et al.	
2004/0044270	A1	3/2004	Barry	
2004/0117032	A1	6/2004	Roth	
2004/0138525	A1	7/2004	Saadat et al.	
2004/0138529	A1	7/2004	Wiltshire et al.	
2004/0193212	A1	9/2004	Taniguchi et al.	
2005/0065397	A1	3/2005	Saadat et al.	
2005/0075538	A1	4/2005	Banik et al.	
2005/0090709	A1	4/2005	Okada et al.	6/104
2005/0119522	A1	6/2005	Okada	
2005/0222495	A1	10/2005	Okada et al.	
2005/0228224	A1	10/2005	Okada et al.	
2005/0234294	A1	10/2005	Saadat et al.	
2005/0234296	A1	10/2005	Saadat et al.	
2005/0250989	A1	11/2005	Suzuki	
2005/0273085	A1	12/2005	Hinman et al.	606/1
2006/0111615	A1	5/2006	Danitz et al.	
2006/0189845	A1	8/2006	Maahs et al.	600/146
2007/0004967	A1	1/2007	Ueno et al.	
2007/0043338	A1	2/2007	Moll et al.	606/1
2007/0156019	A1	7/2007	Larkin et al.	
2007/0167679	A1	7/2007	Miyamoto et al.	
2007/0167680	A1	7/2007	Miyamoto et al.	
2007/0232856	A1	10/2007	Ueno et al.	
2007/0270640	A1*	11/2007	Dimitriou et al.	600/106
2007/0299387	A1	12/2007	Williams et al.	
2008/0051631	A1	2/2008	Dejima et al.	
2008/0065109	A1	3/2008	Larkin	606/130
2008/0221391	A1*	9/2008	Weitzner et al.	600/118
2008/0262294	A1	10/2008	Ewers et al.	

FOREIGN PATENT DOCUMENTS

EP	1 872 709	A	1/2008
EP	1 967 123	A1	9/2008
JP	55-45436		3/1980
JP	56-104501		8/1981
JP	63-102401		7/1988
JP	S63-242217		10/1988
JP	5-5105	U	1/1993
JP	5-49594		3/1993
JP	8-131441		5/1996
JP	08322787	A	12/1996
JP	10-258022		9/1998
JP	11-318815	A	11/1999
JP	2001-46393	A	2/2001
JP	2002-253563	A	9/2002
JP	2004-180781		7/2004
JP	2004-290569		10/2004
JP	2005-287963		10/2005
JP	2005-296412		10/2005
JP	2006-141624		6/2006
JP	2006-516910	A	7/2006
JP	516910		7/2006
JP	2007-151595		6/2007
JP	2007-175070		7/2007
JP	2007-275624	A	10/2007
JP	2005261688	A	9/2009
WO	WO 2004/064600	A2	8/2004
WO	2005/009227	A1	2/2005
WO	WO 2007/057880	A2	5/2007
WO	WO 2007/074571	A1	7/2007
WO	WO 2007/080974	A1	7/2007
WO	WO 2007/127199	A1	11/2007

OTHER PUBLICATIONS

U.S. Office Action dated Mar. 24, 2010, received in related U.S. Appl. No. 11/435,183.
U.S. Office Action dated Mar. 2, 2011 received in related U.S. Appl. No. 11/652,880.
U.S. Office Action dated Mar. 16, 2011 received in related U.S. Appl. No. 11/435,183.
U.S. Office Action dated Jul. 9, 2010.
Office Action dated Oct. 5, 2011 from corresponding U.S. Appl. No. 11/652,880.
Office Action dated May 15, 2012 received in related U.S. Appl. No. 11/652,880.
U.S. Office Action dated Mar. 28, 2012 of related U.S. Appl. No. 13/212,610.
Japanese Notice of Allowance dated Jun. 4, 2013 issued in corresponding Application No. 2009-013615 together with an English Language Translation.
Extended Supplementary European Search Report dated Jul. 18, 2014 from related European Application No. 07 70 6679.3.
Notice of Allowance dated Jan. 22, 2013 issued in corresponding U.S. Appl. No. 11/652,880.
U.S. Office Action mailed May 31, 2012 in related U.S. Appl. No. 12/024,704.
U.S. Office Action mailed Jun. 6, 2012 in related U.S. Appl. No. 12/127,449.
U.S. Office Action mailed Jun. 26, 2012 in related U.S. Appl. No. 12/058,029.
U.S. Office Action mailed Jul. 3, 2012 in related U.S. Appl. No. 12/035,535.
Chinese Office Action dated Jul. 3, 2012 from related Chinese Patent Application Publication No. 2007-80008372.7, together with an English language translation.
Japanese Notice of Allowance dated Aug. 20, 2013 issued in corresponding Application No. 2009-058066 with an English language Translation.
U.S. Office Action dated Mar. 19, 2013 issued in corresponding U.S. Appl. No. 12/058,029.
Japanese Office Action (Notice of Reasons for Rejection) dated Dec. 18, 2012 from corresponding Japanese Patent Application Publication No. JP 2009-013615, together with an English language translation.
Japanese Office Action (Notice of Reasons for Rejection) dated Dec. 18, 2012 from corresponding Japanese Patent Application Publication No. JP 2009-027835, together with an English language translation.
Japanese Office Action (Notice of Reasons for Rejection) dated Dec. 18, 2012 from corresponding Japanese Patent Application Publication No. JP 2009-033278, together with an English language translation.
Japanese Office Action dated Feb. 19, 2013 together with an English Translation issued in corresponding Japanese Application No. 2009058066.
Office Action dated Dec. 16, 2014 received in related U.S. Patent Application, namely U.S. Appl. No. 12/035,535.

* cited by examiner

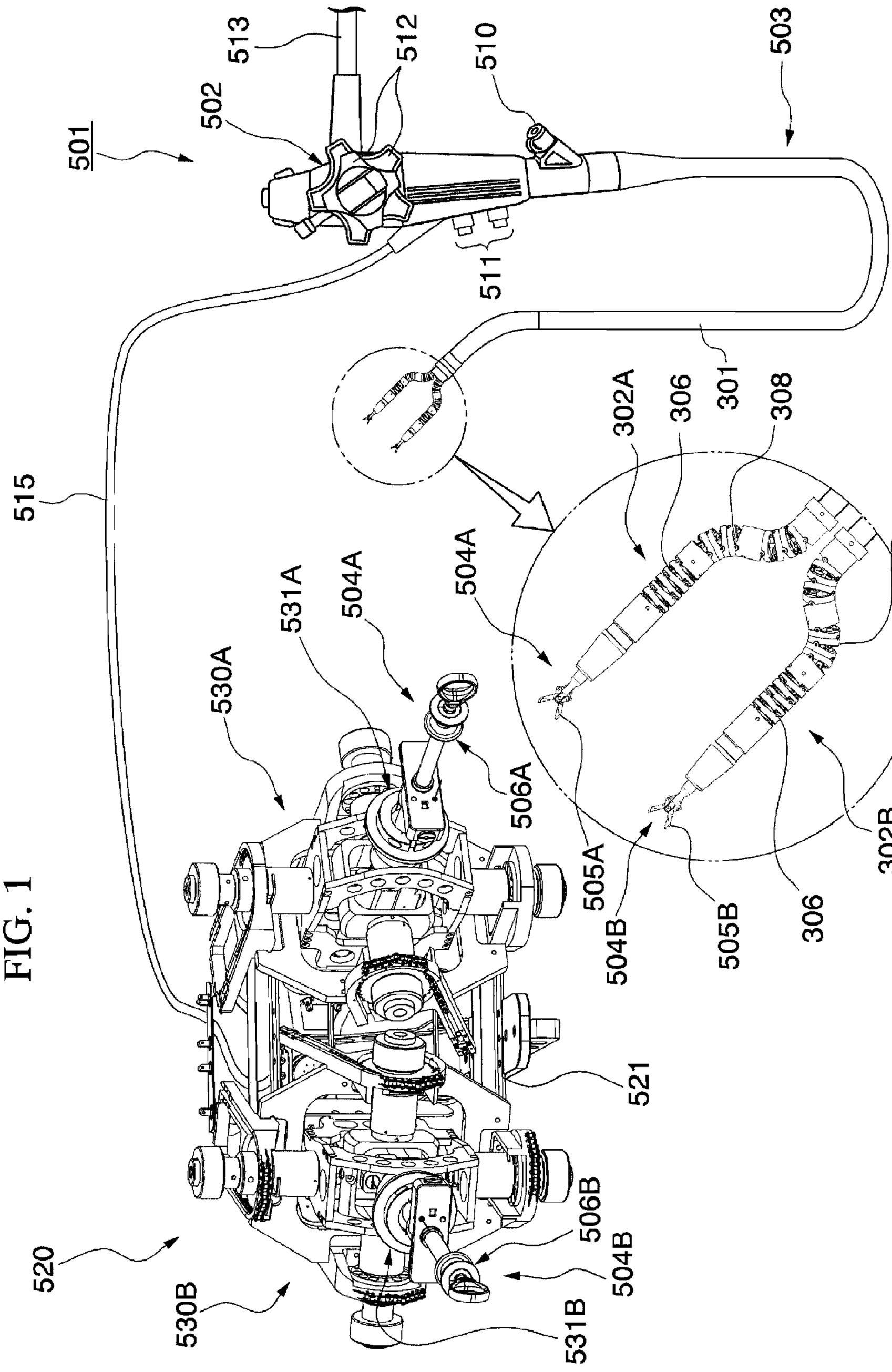

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FIG. 1

FIG. 2

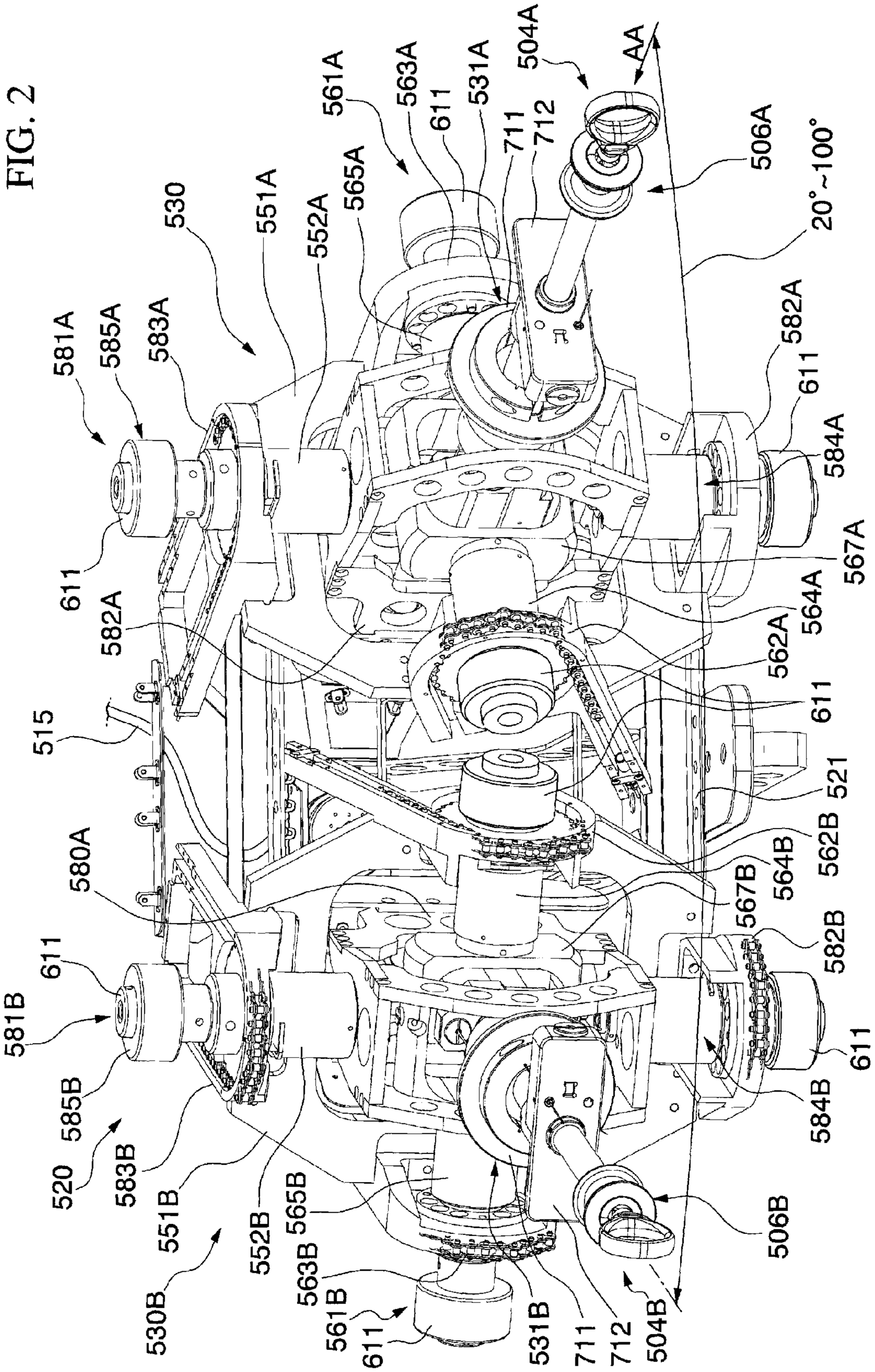
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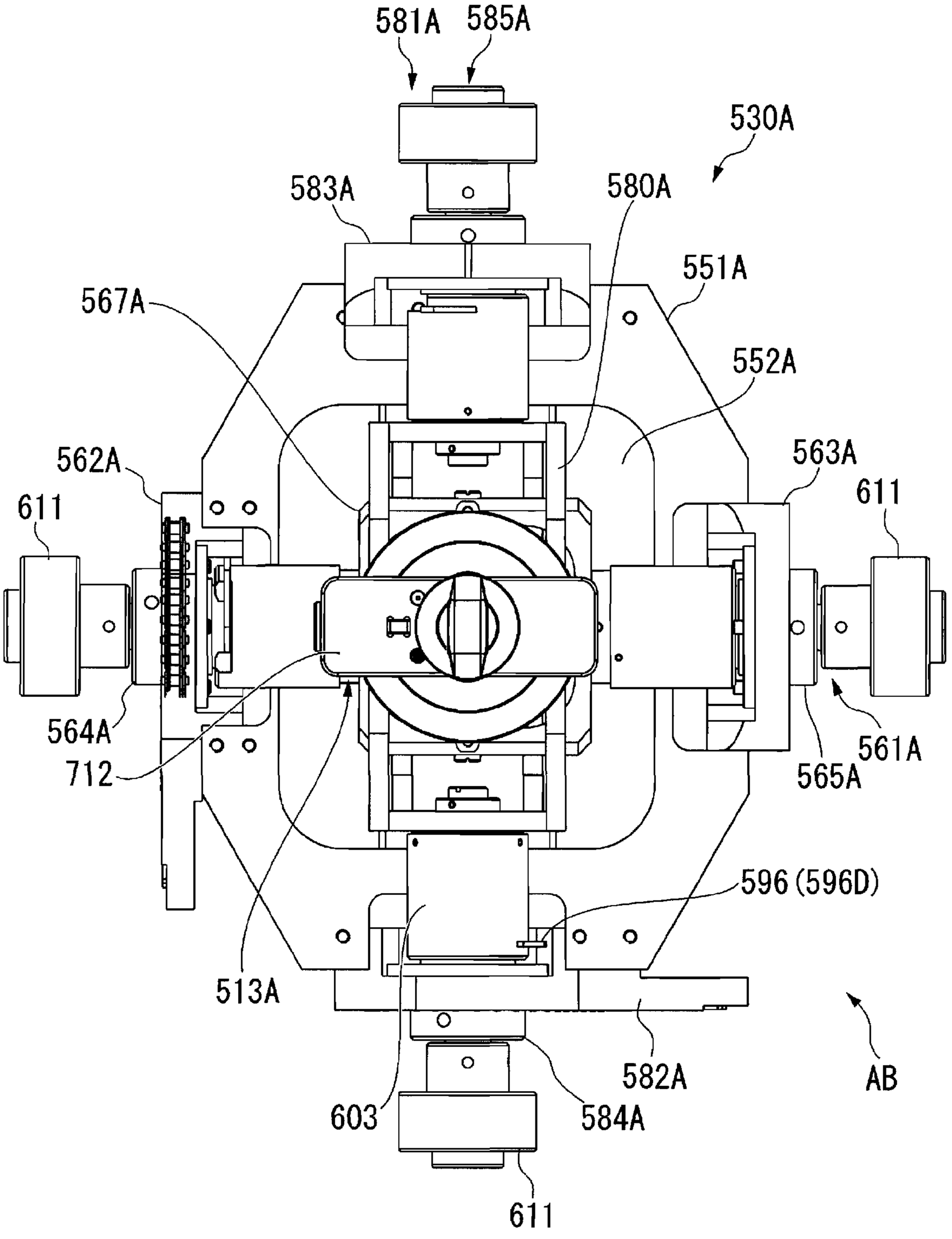
FIG. 3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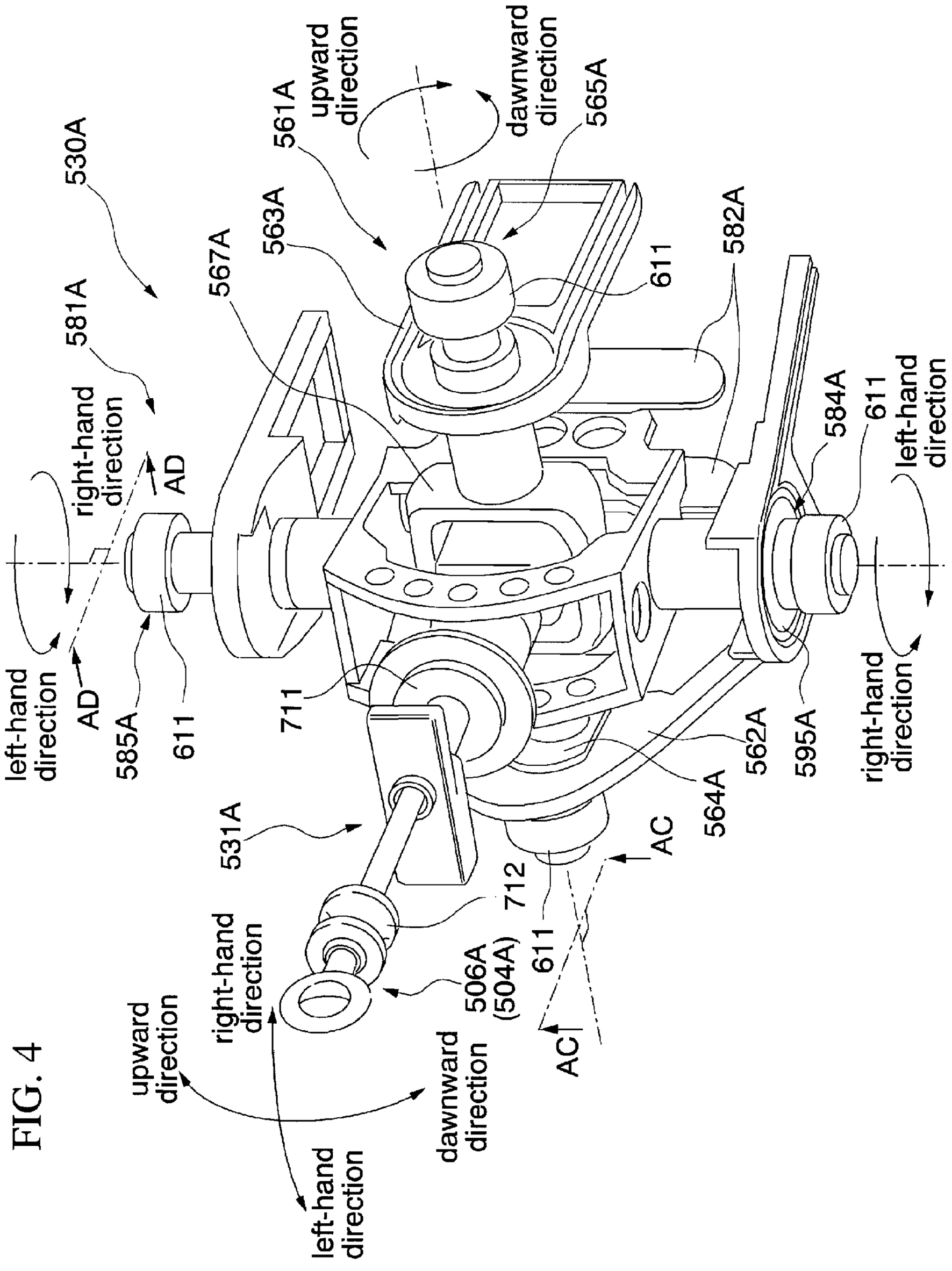
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611
711
584A
611
left-hand direction
531A
712
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right-hand direction
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dawnward direction
left-hand direction

FIG. 4

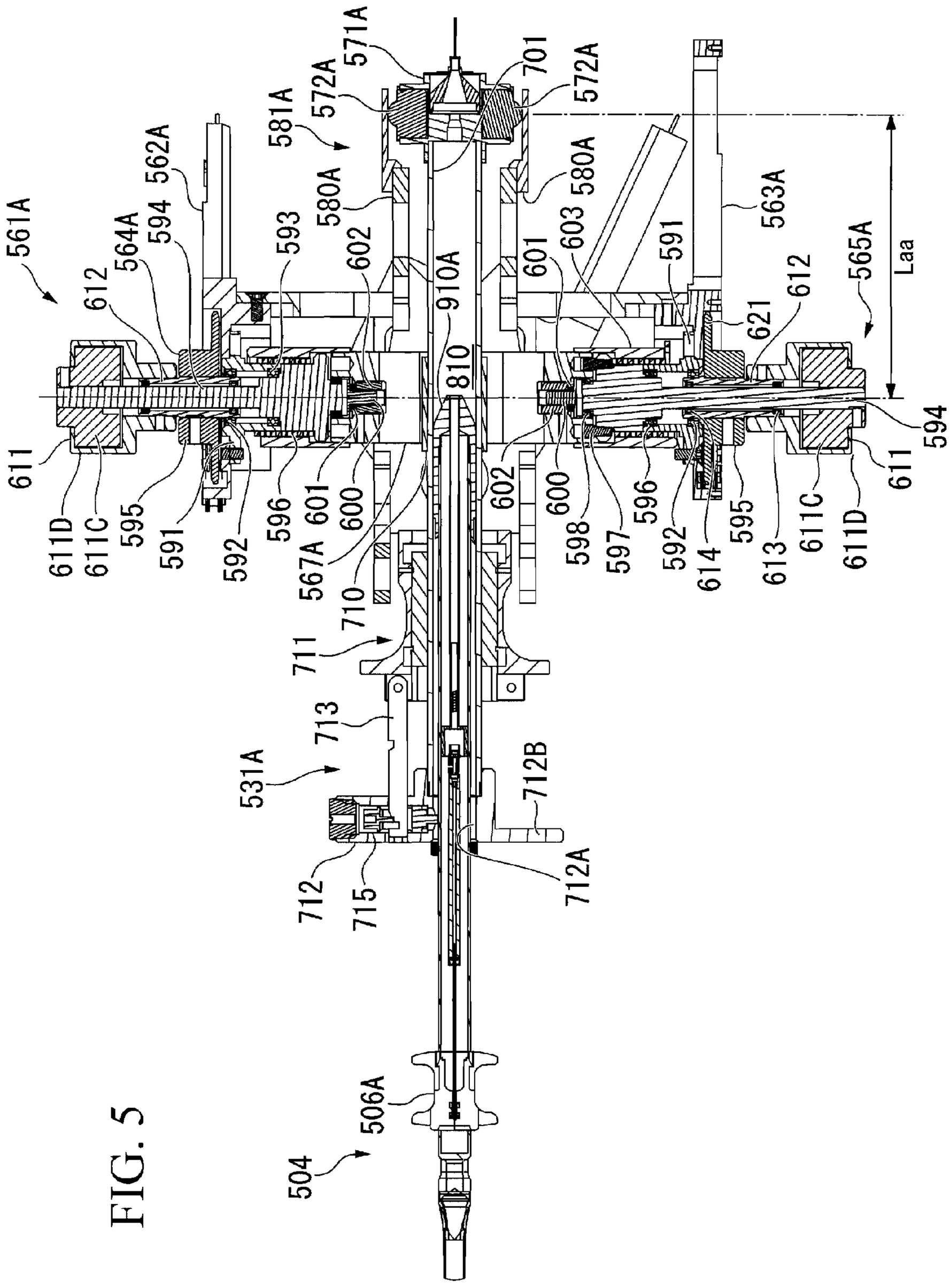
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FIG. 5

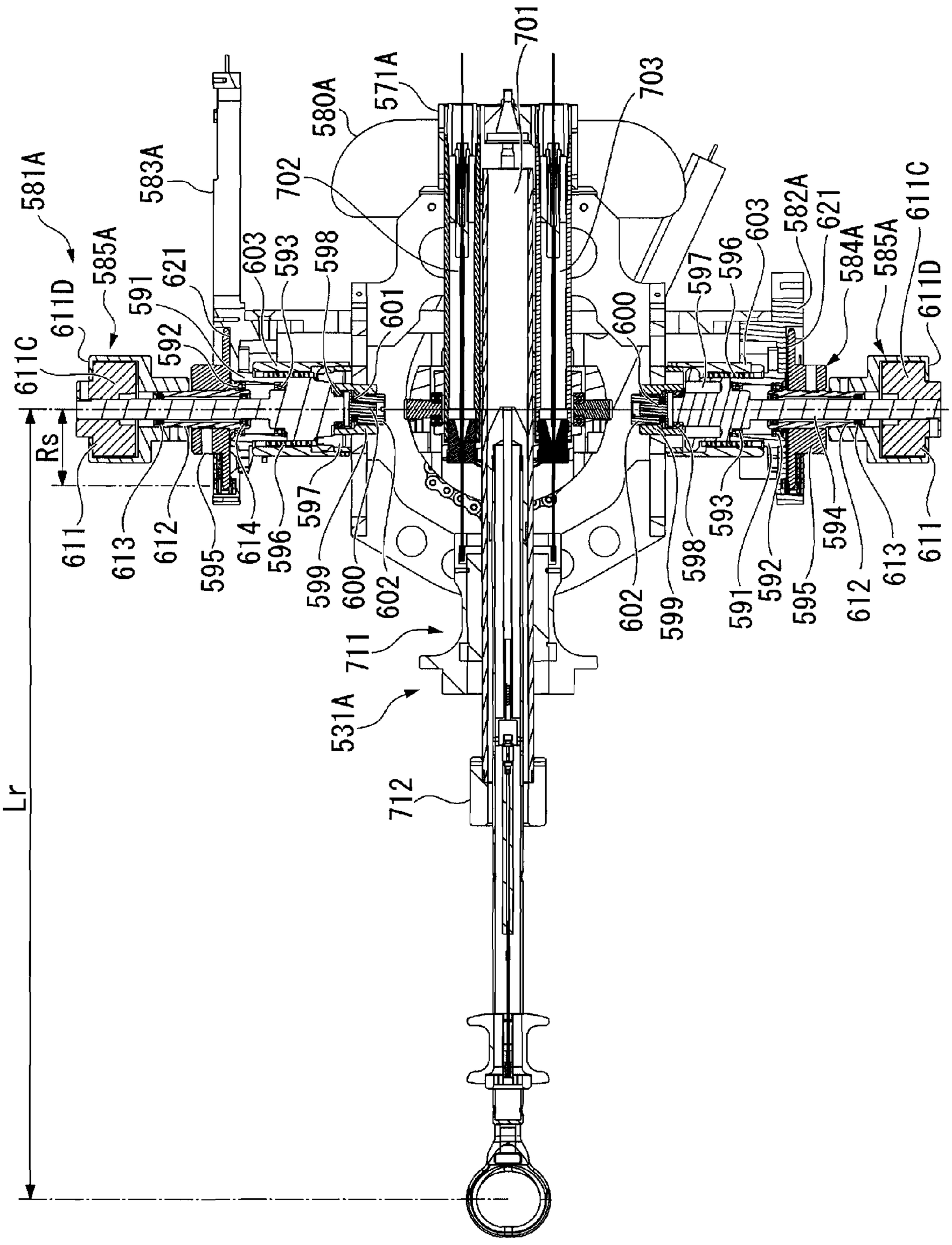
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FIG. 6

FIG. 7

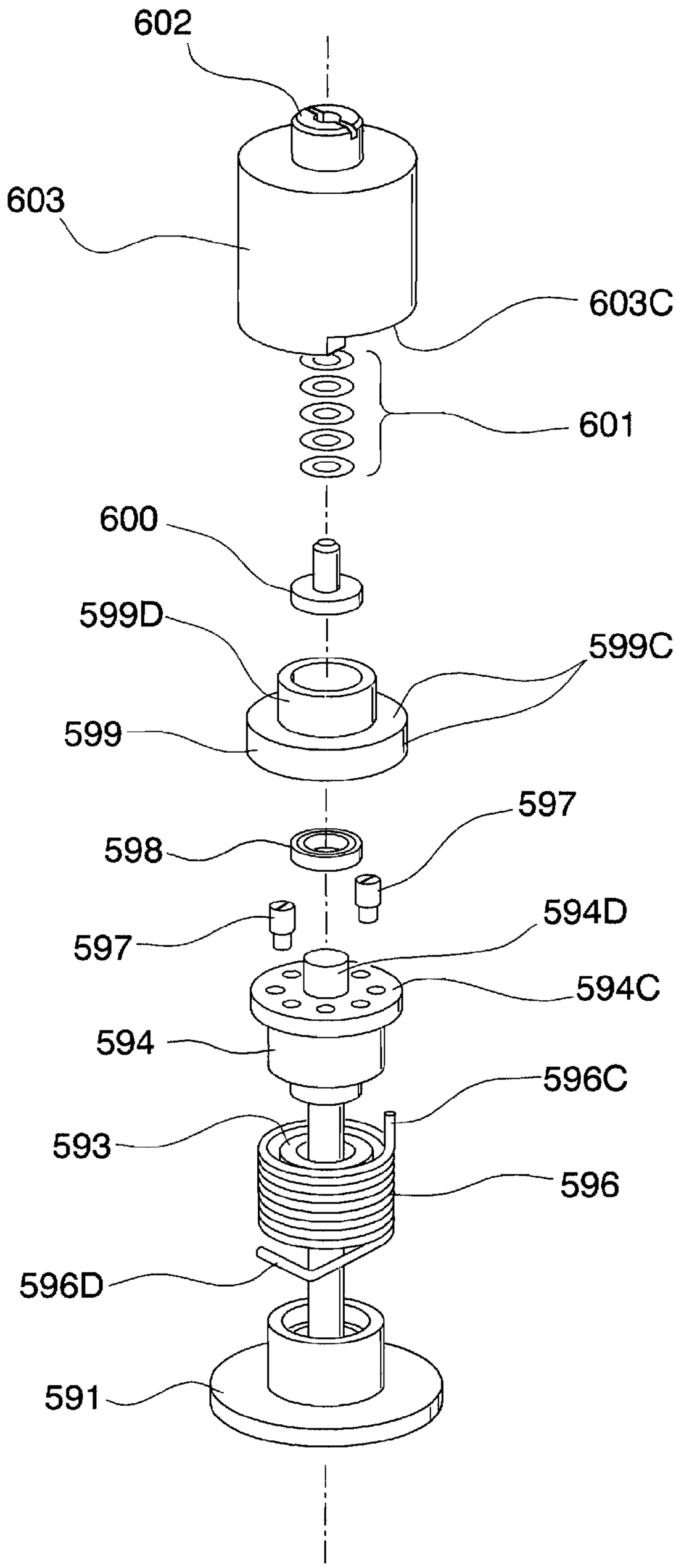
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FIG. 8

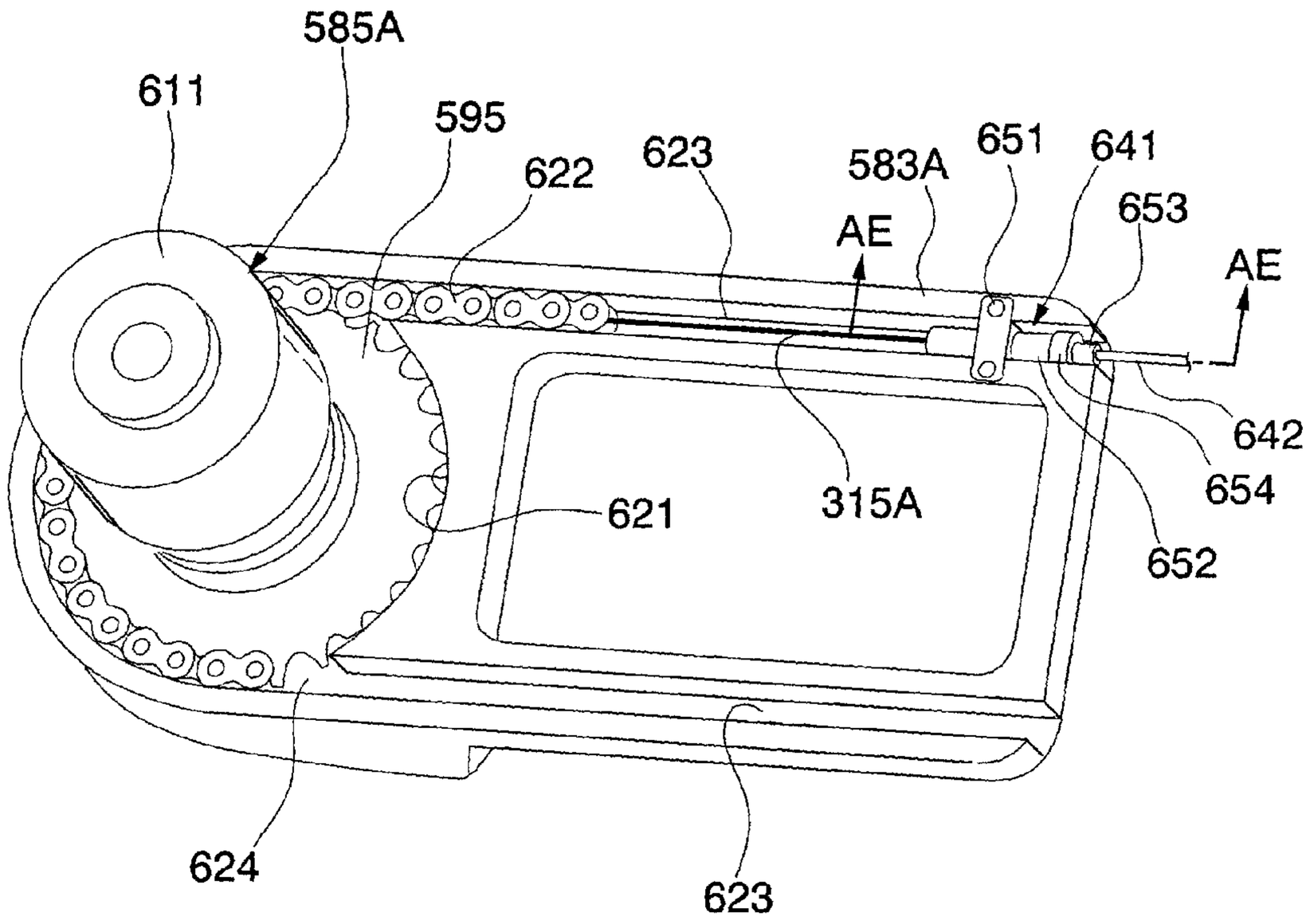
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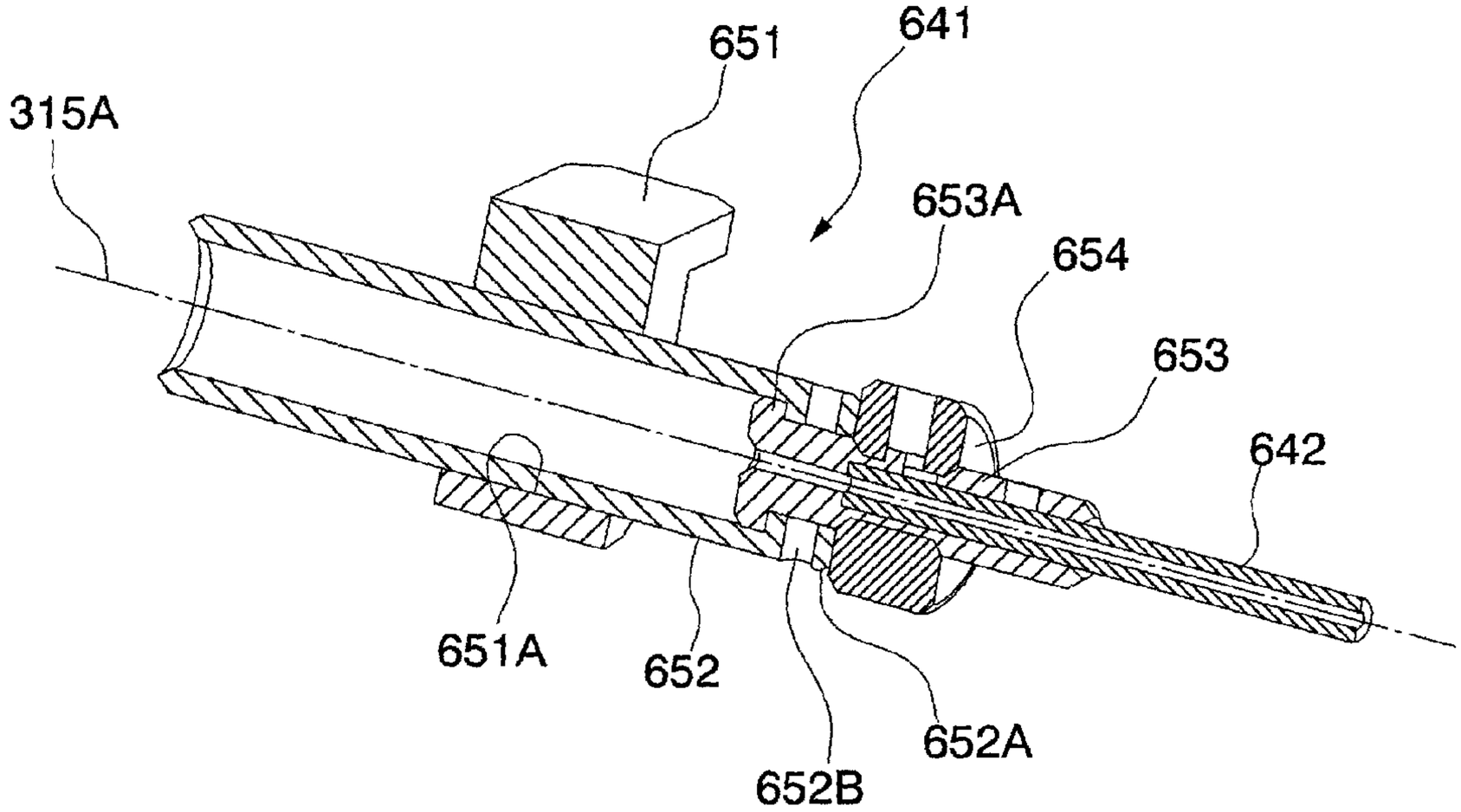
FIG. 9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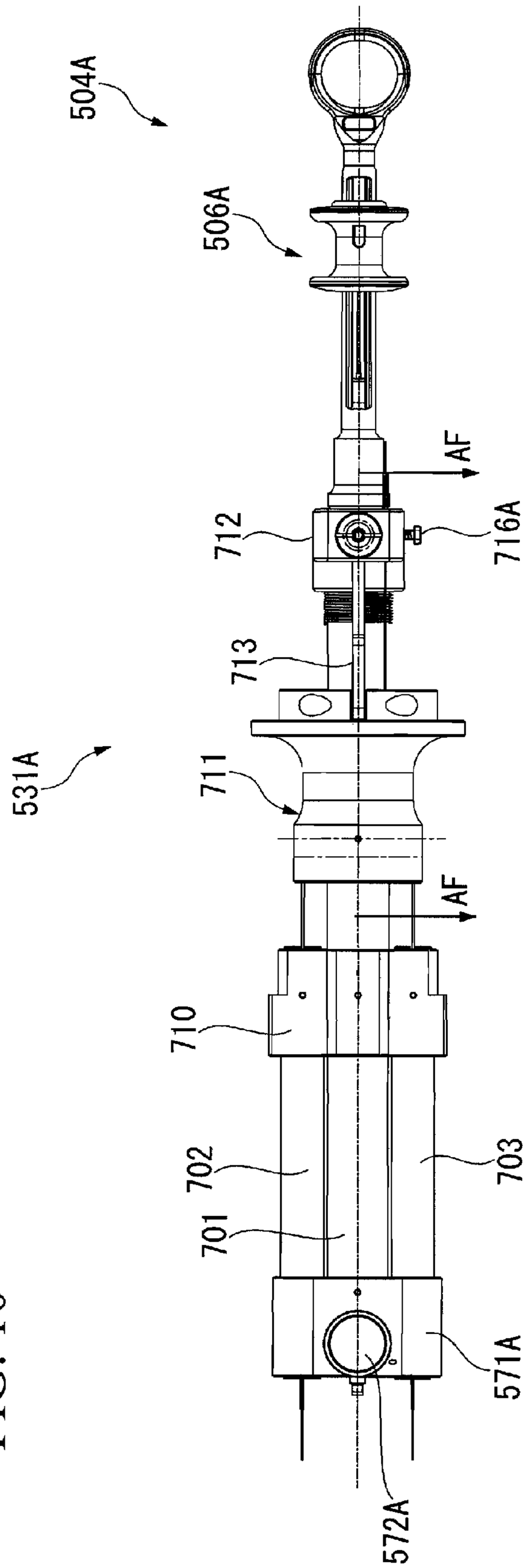

FIG. 10

FIG. 11

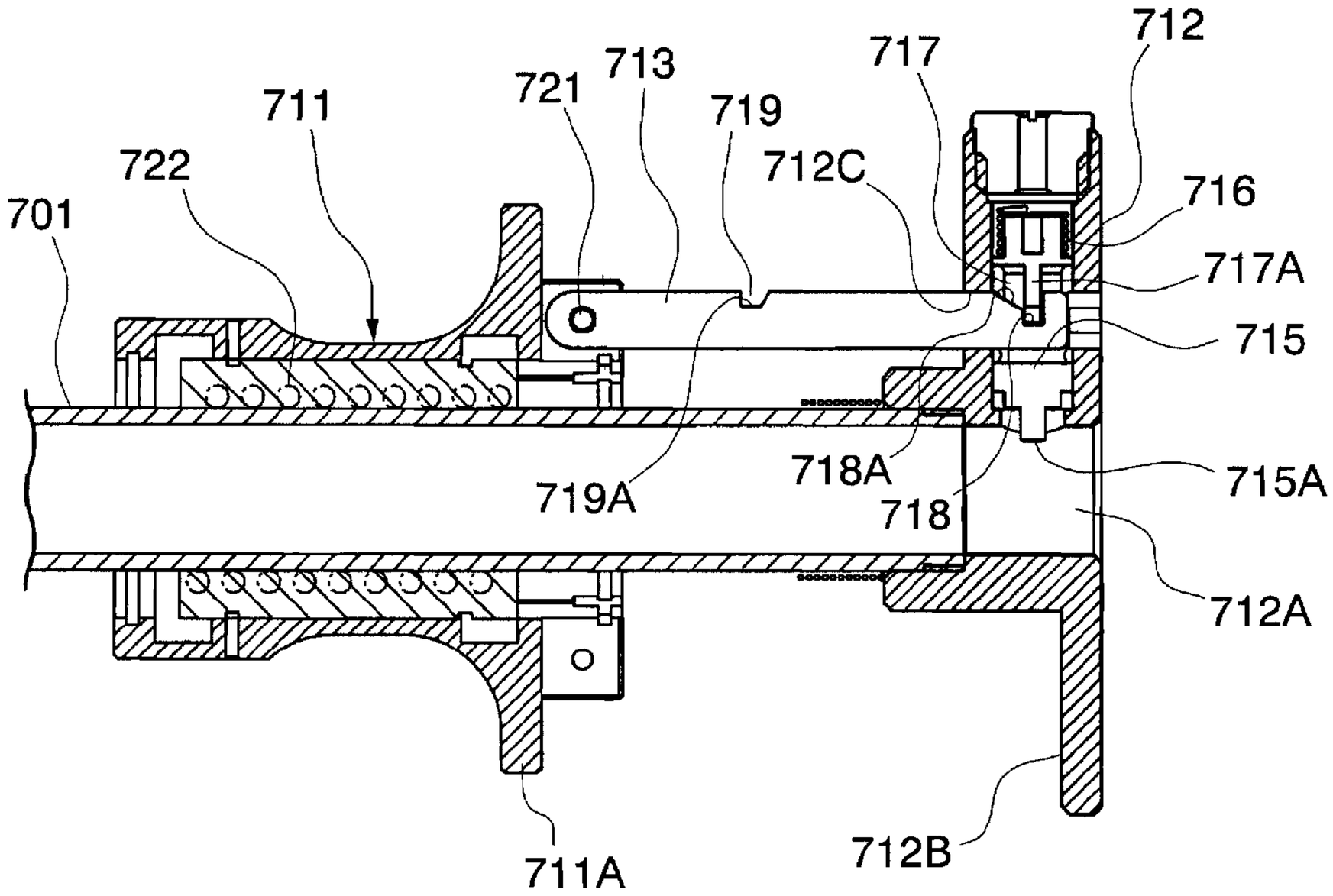
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FIG. 12

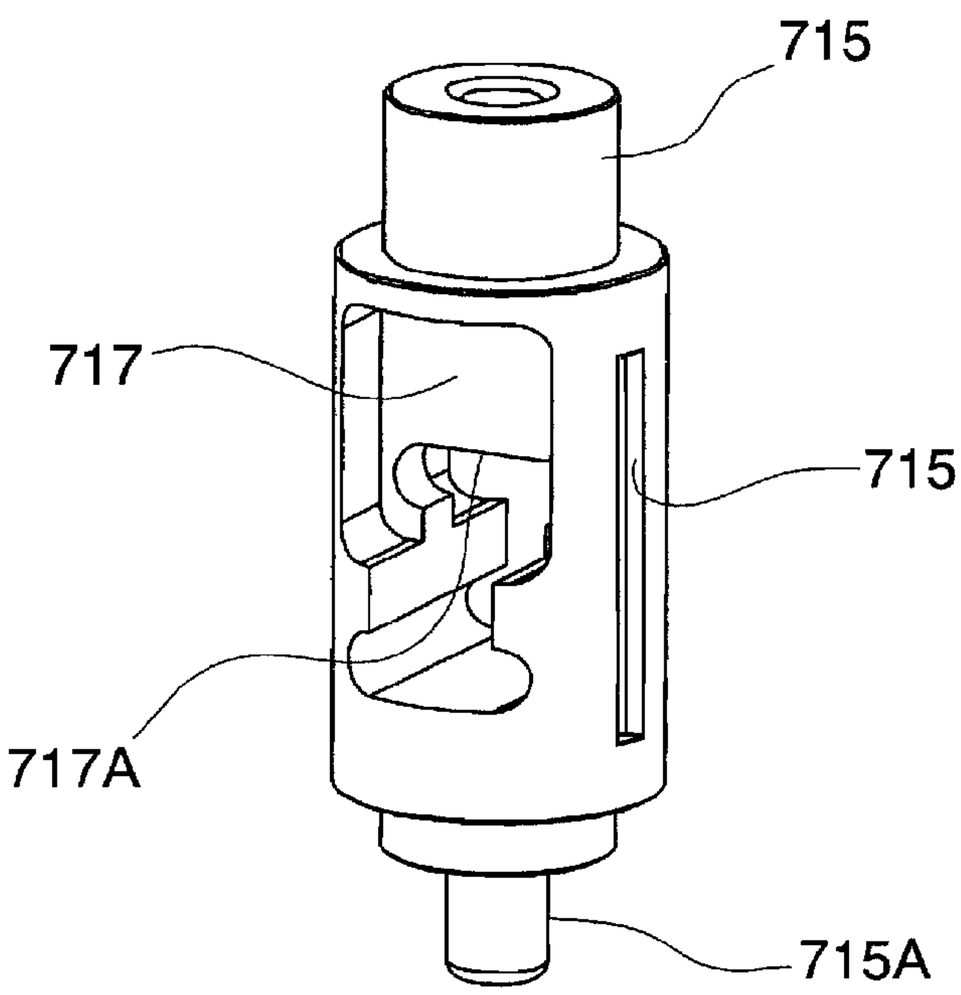
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FIG. 13

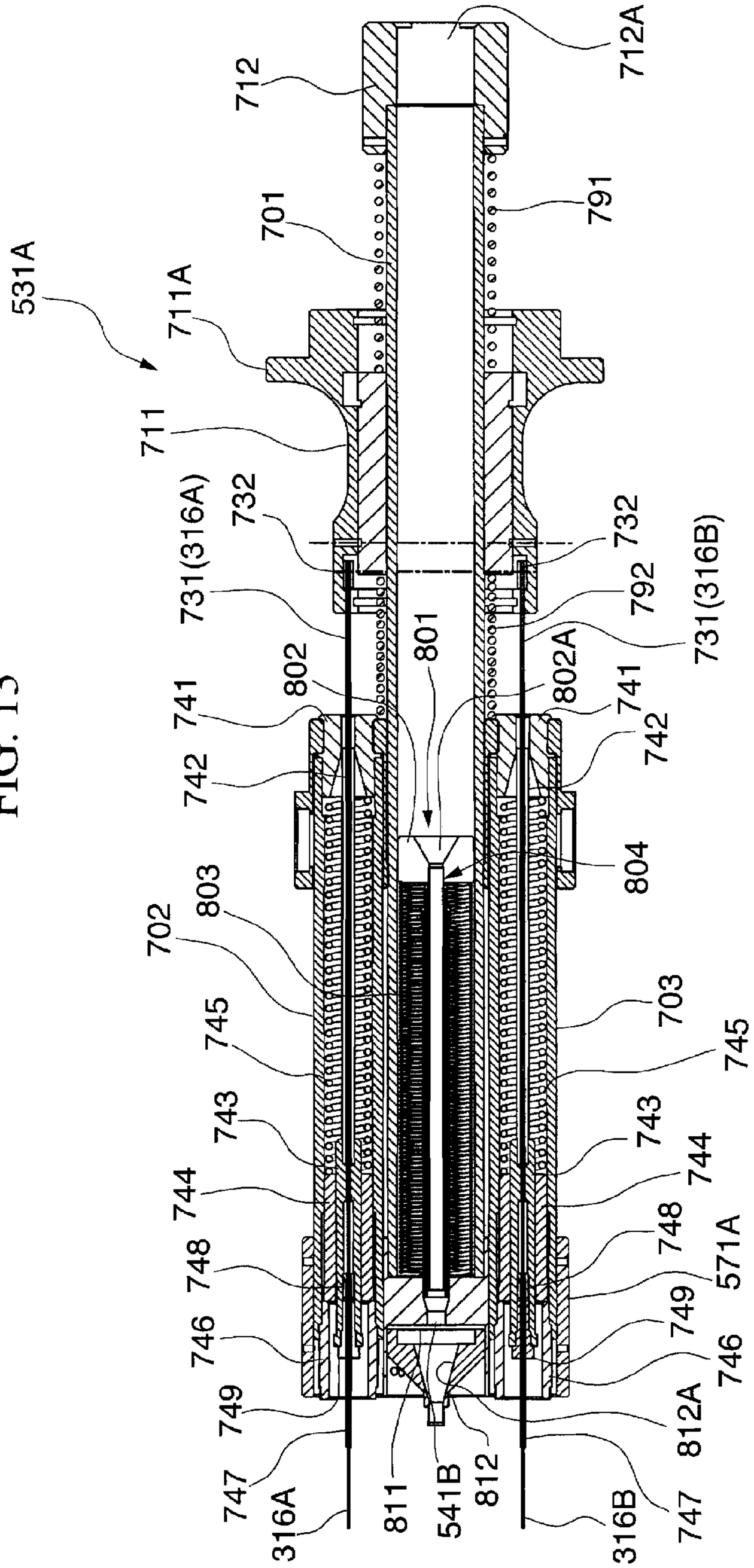
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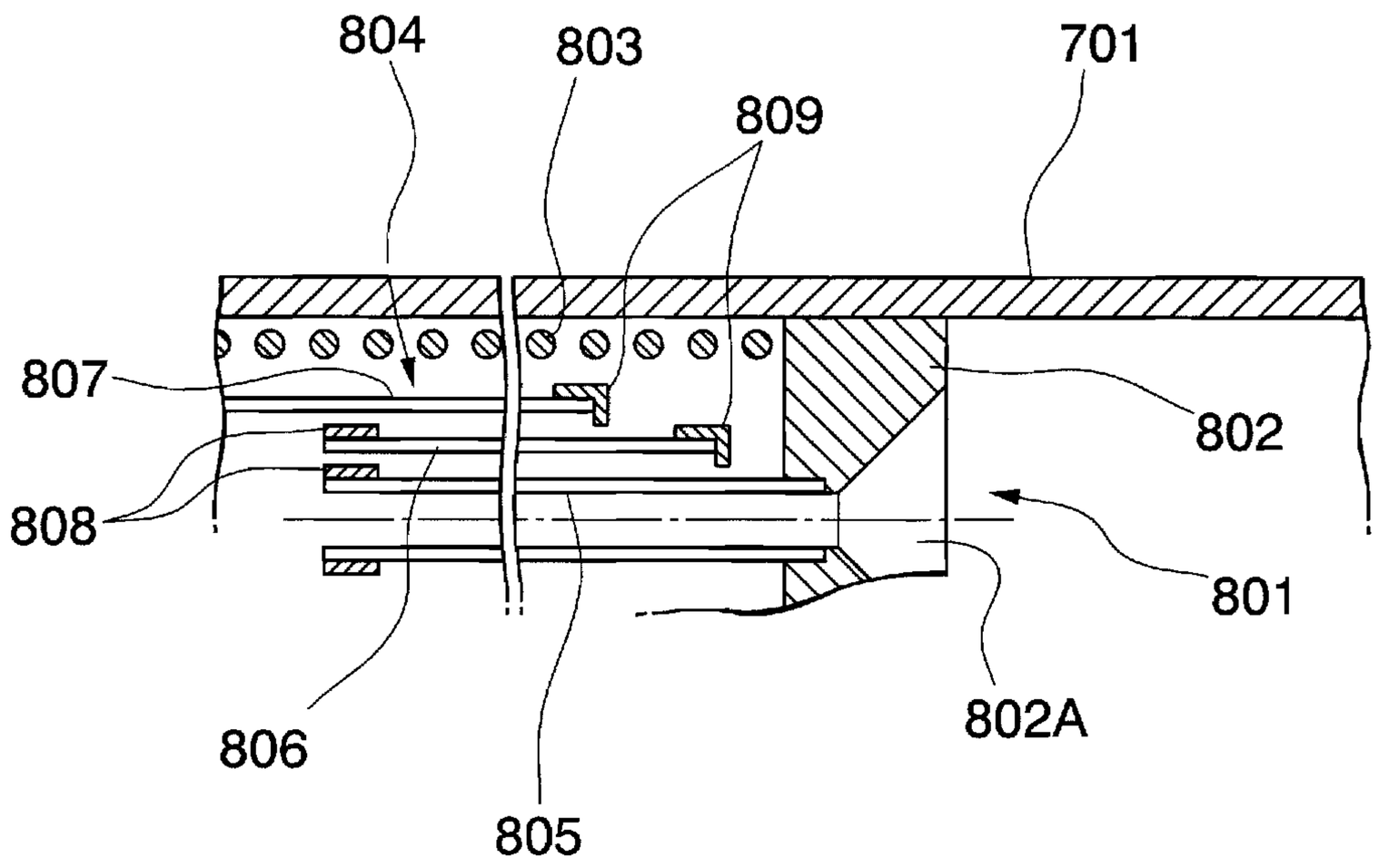
FIG. 14



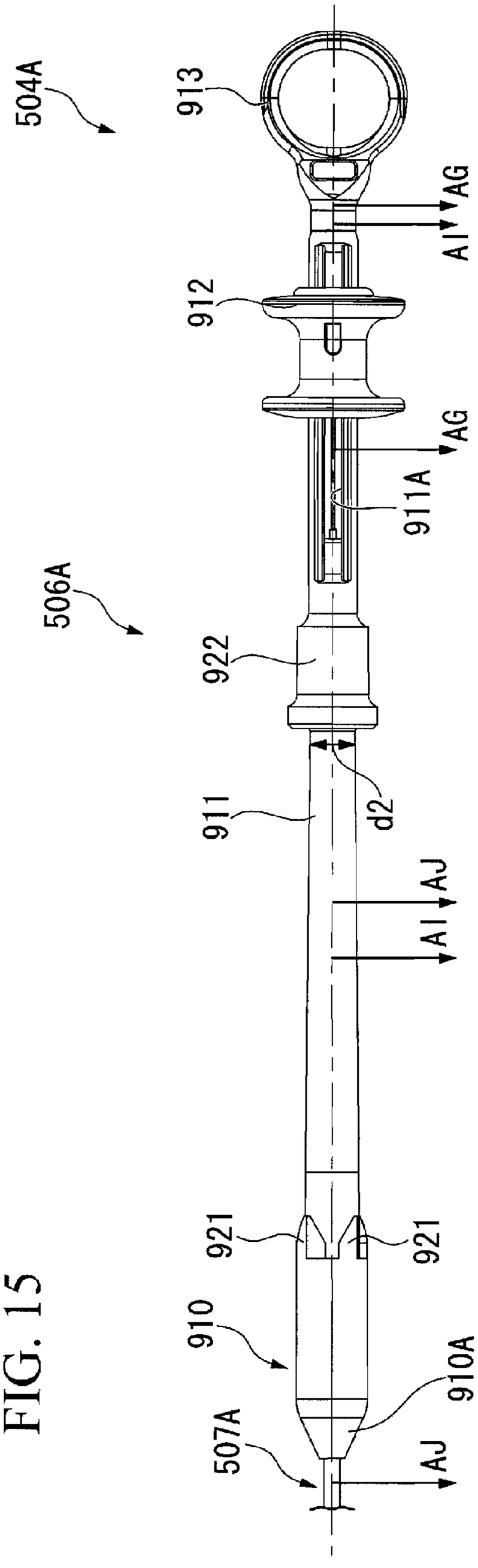

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FIG. 15

FIG. 16

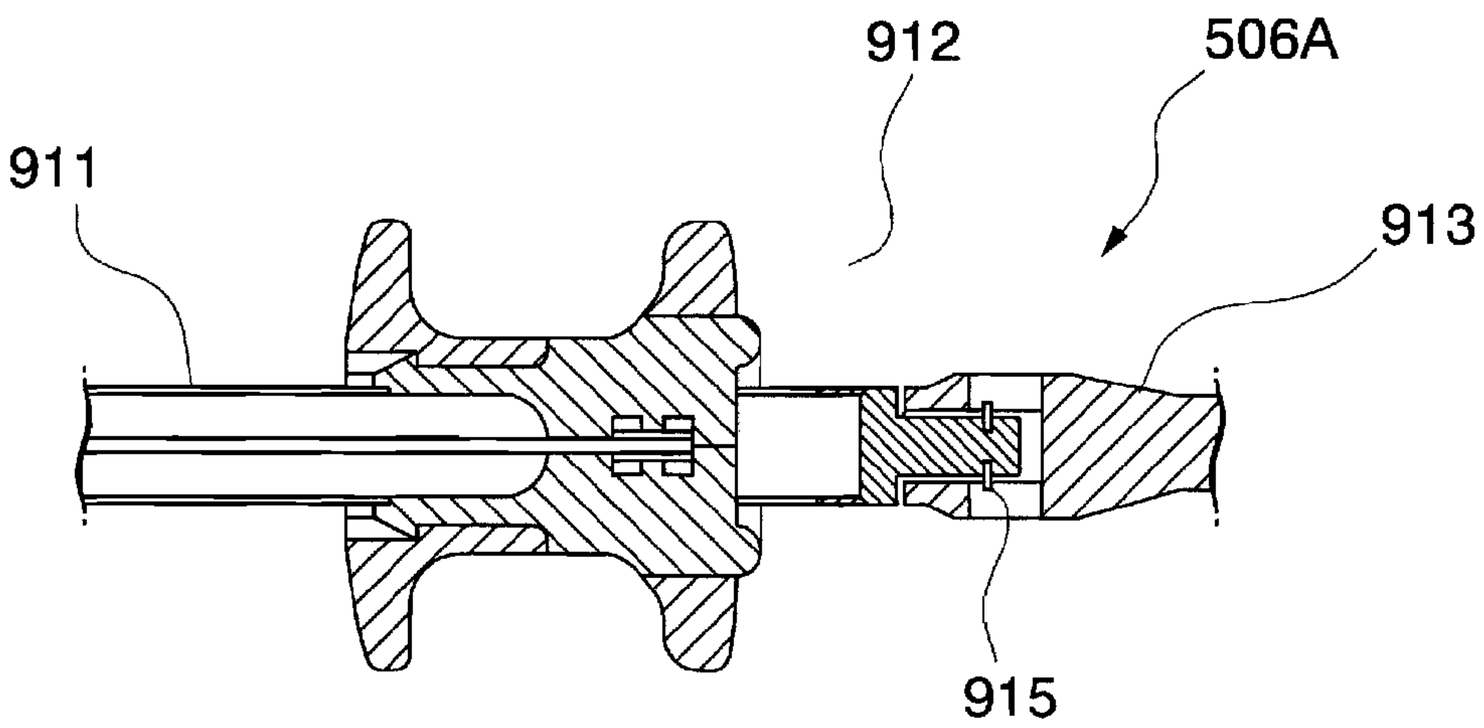
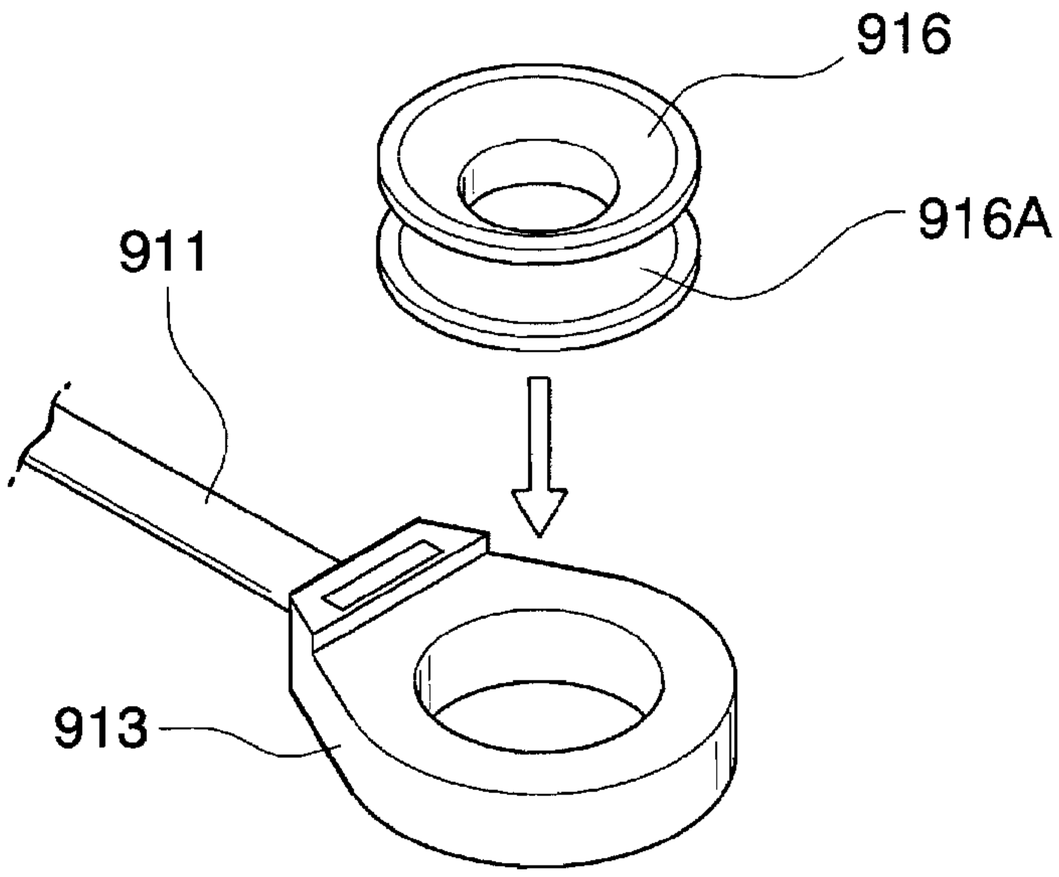


FIG. 17



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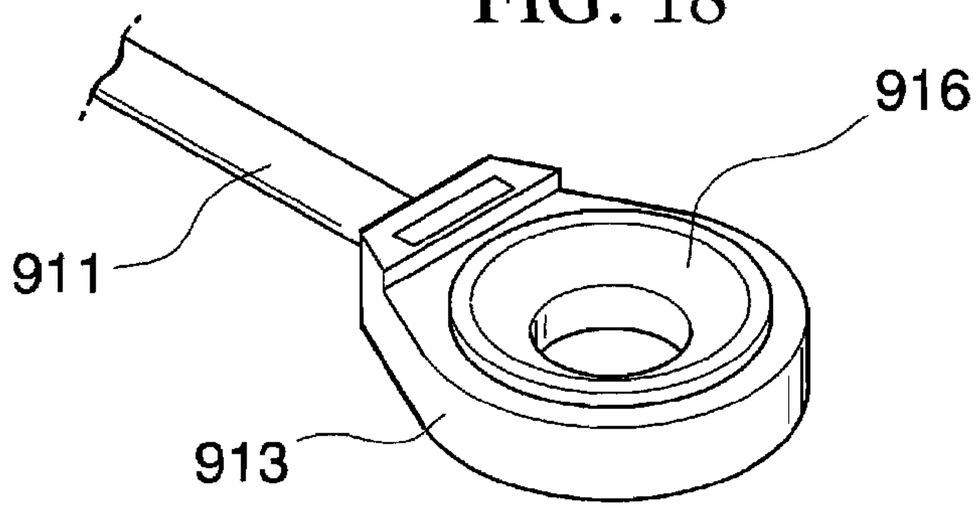
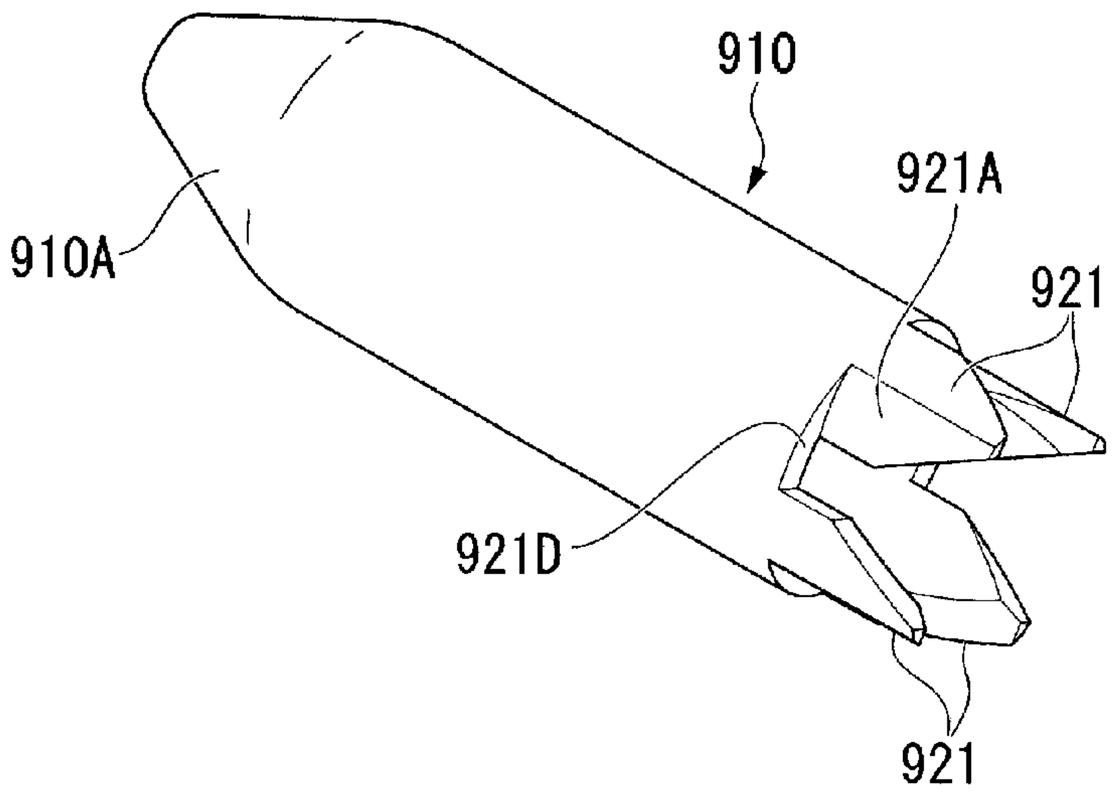


FIG. 19A



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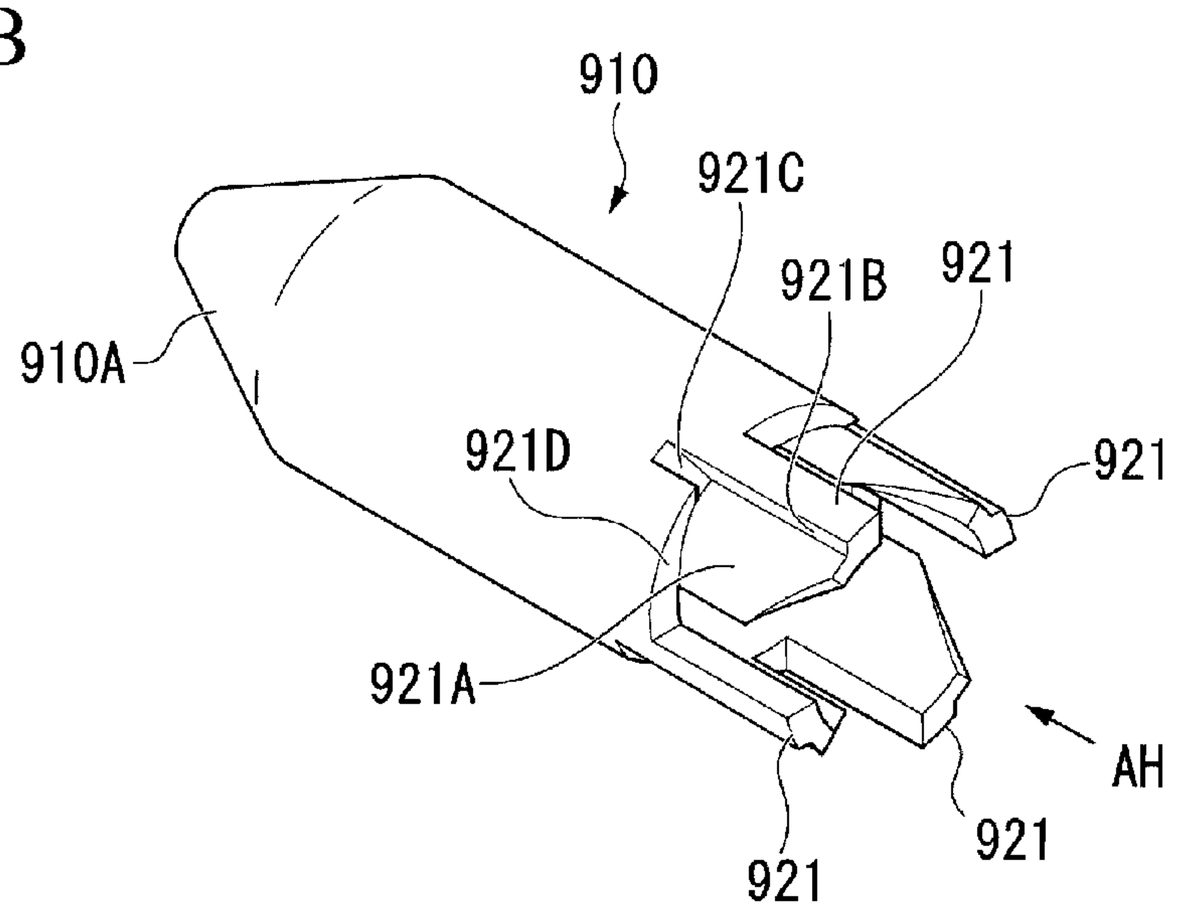

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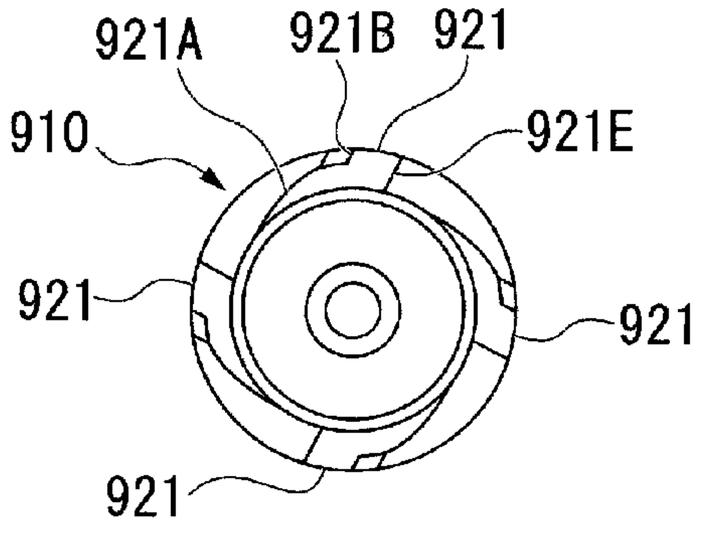

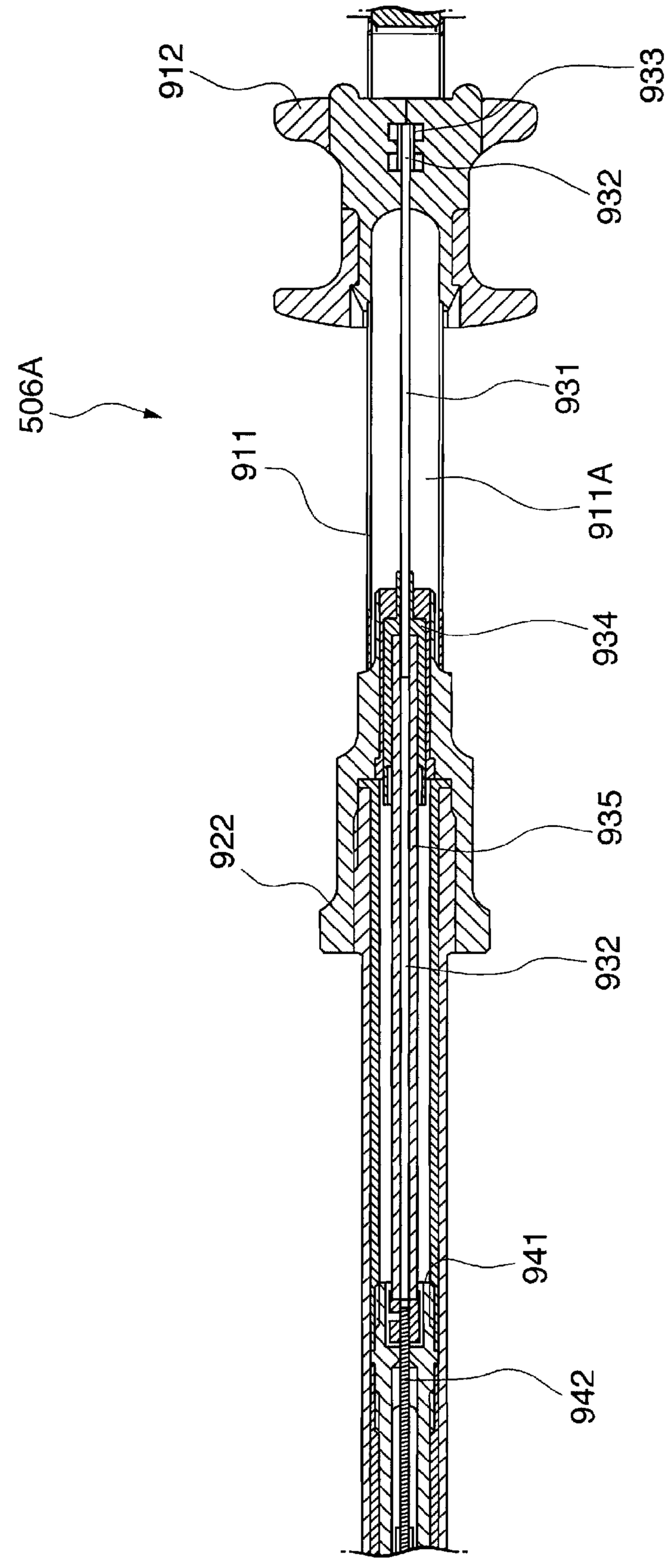

FIG. 21

FIG. 22

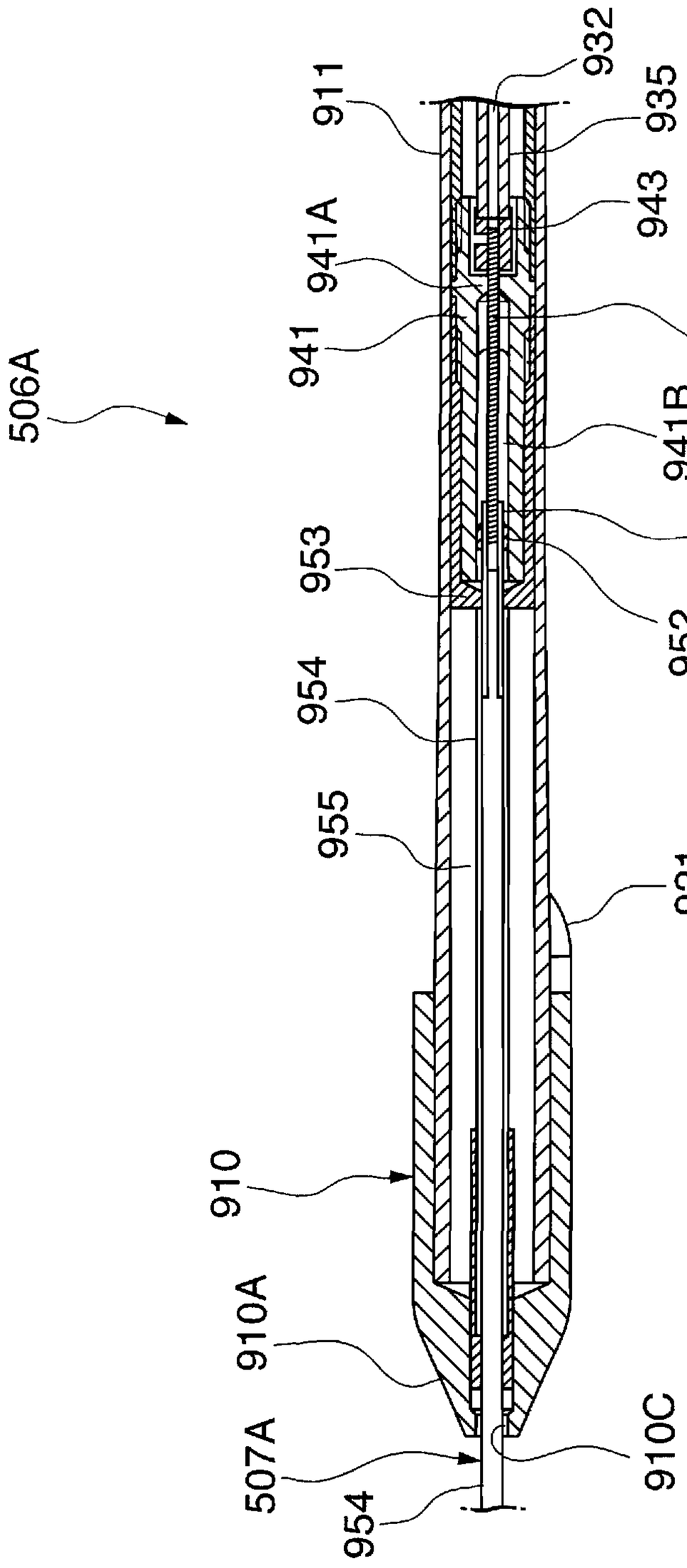
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FIG. 23

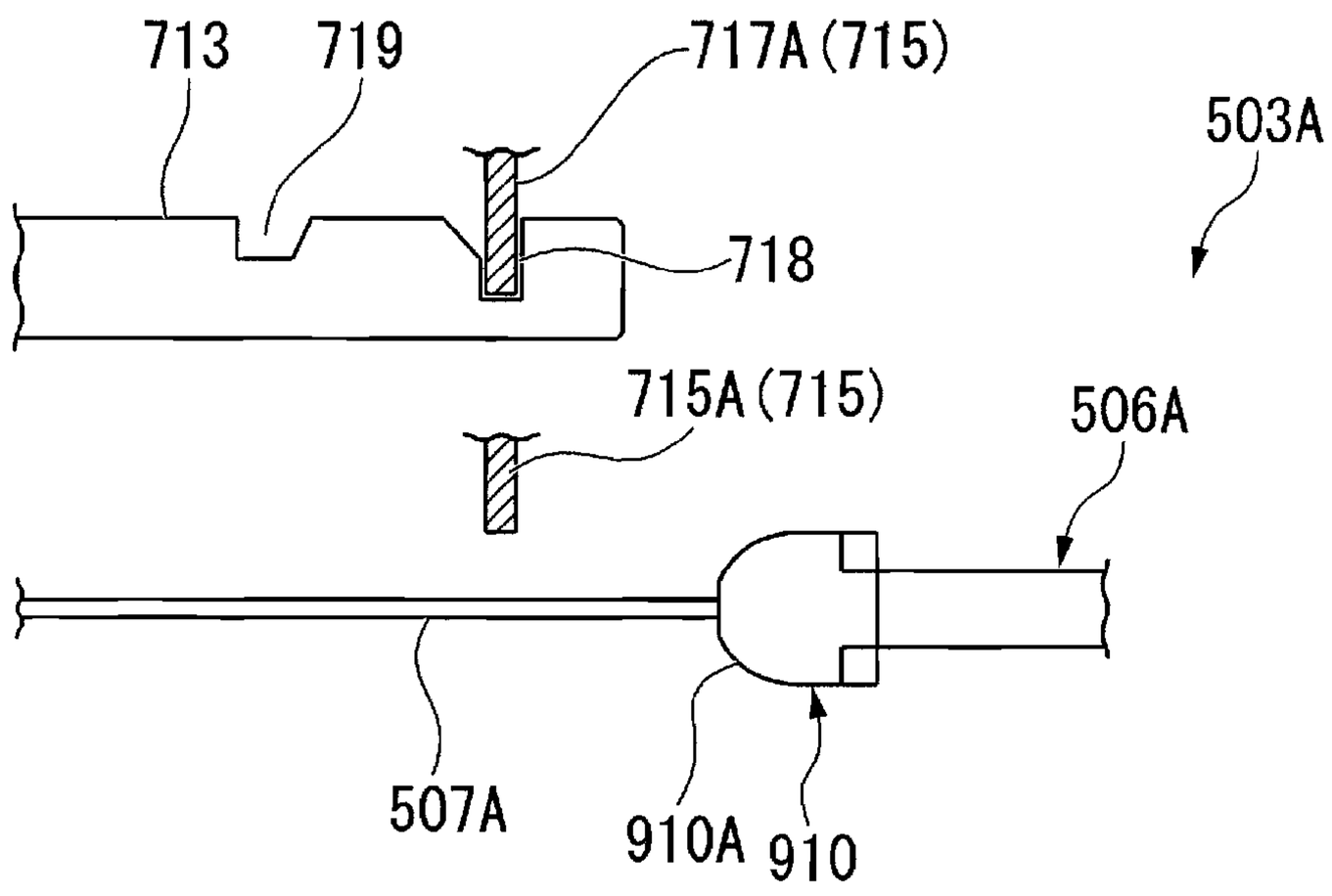
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FIG. 24

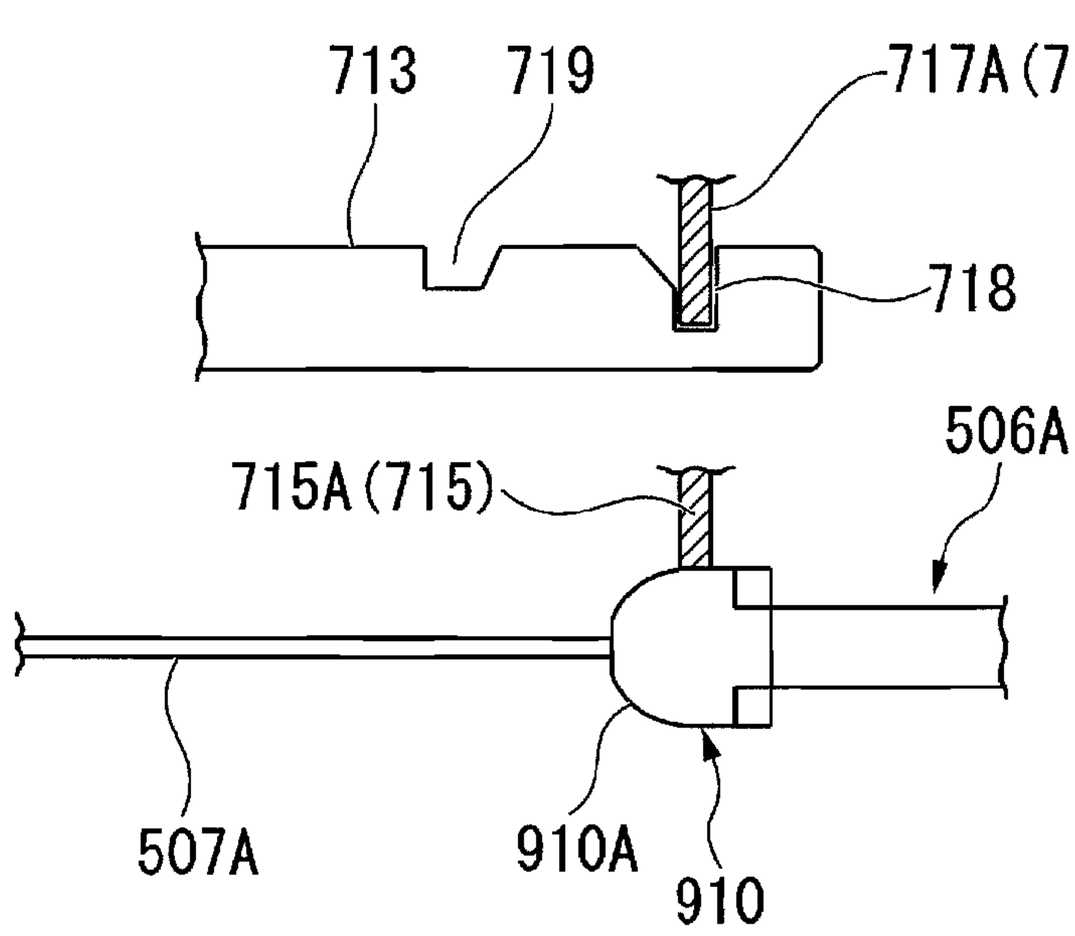

713
719
717A(715)
718
506A
715A(715)
507A
910A
910

FIG. 25

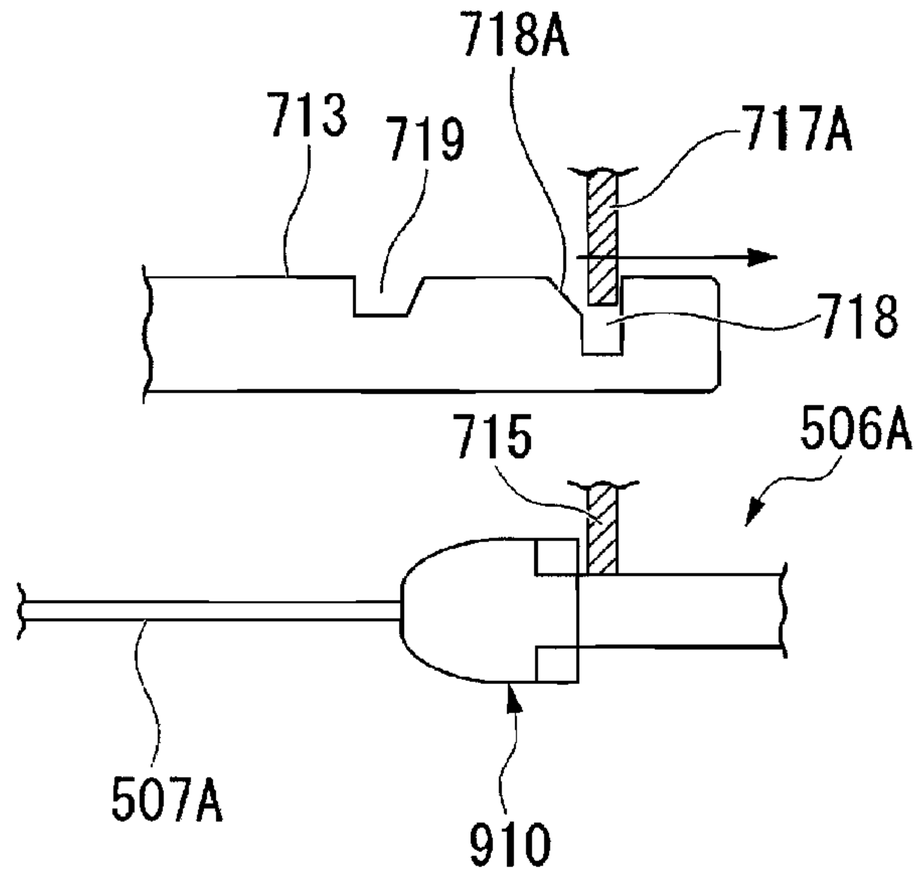


FIG. 26

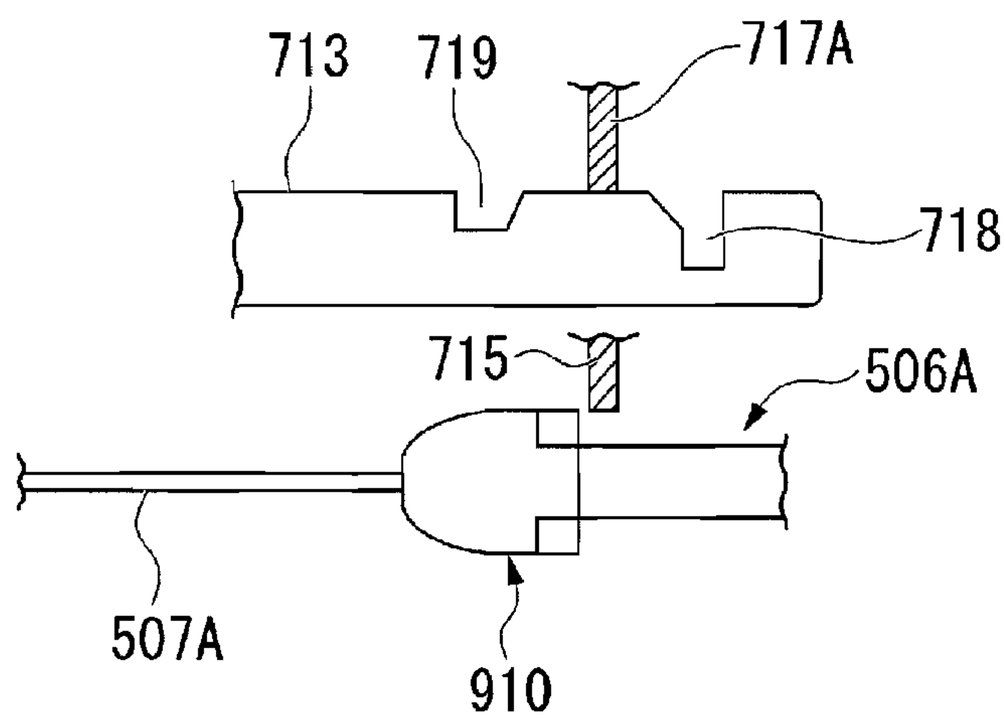


FIG. 27

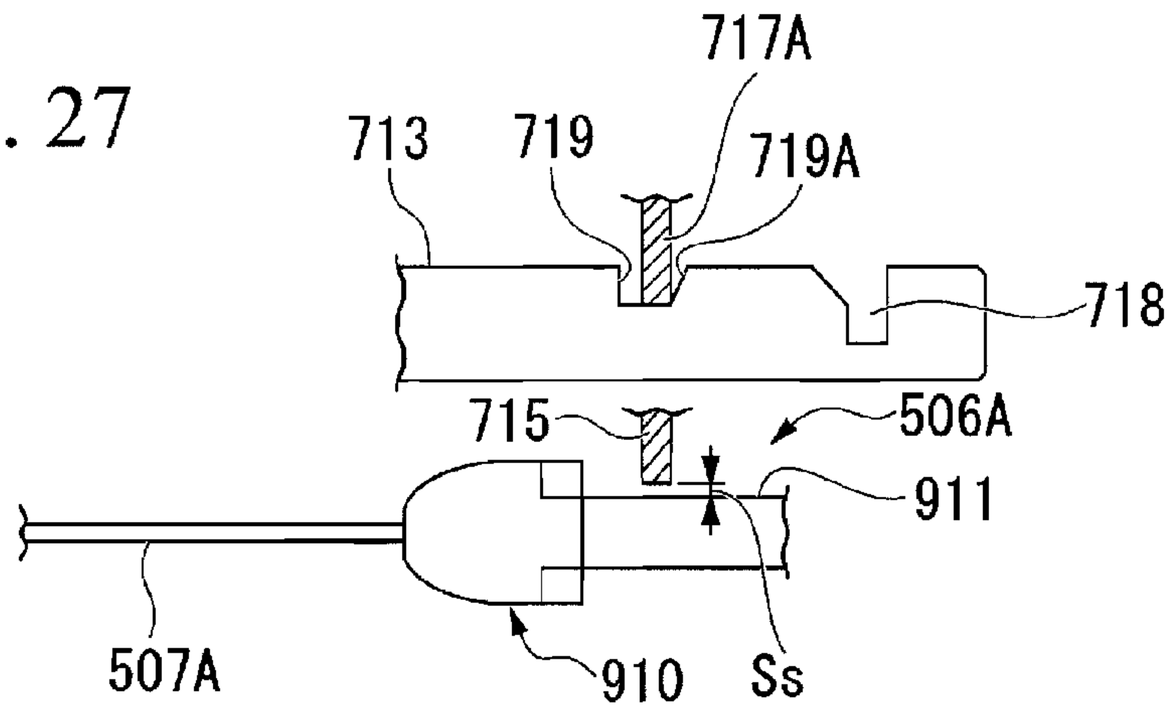


FIG. 28

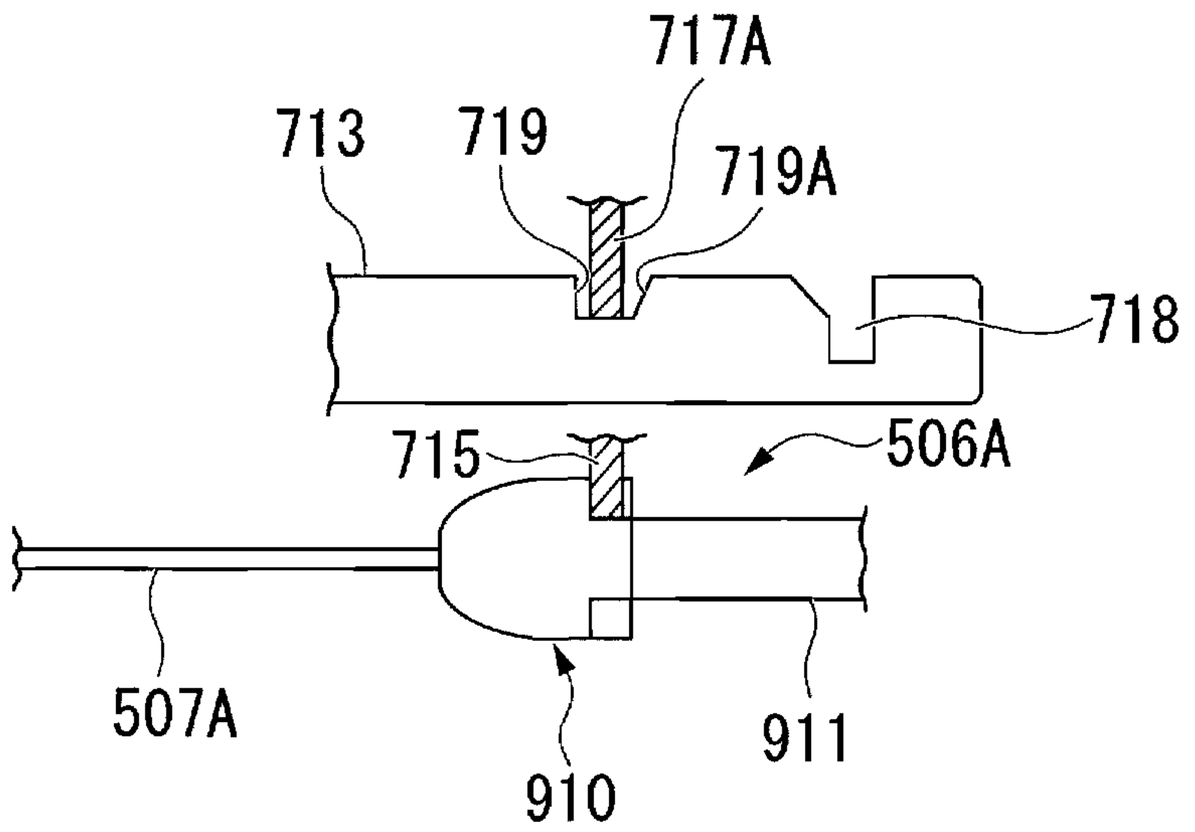
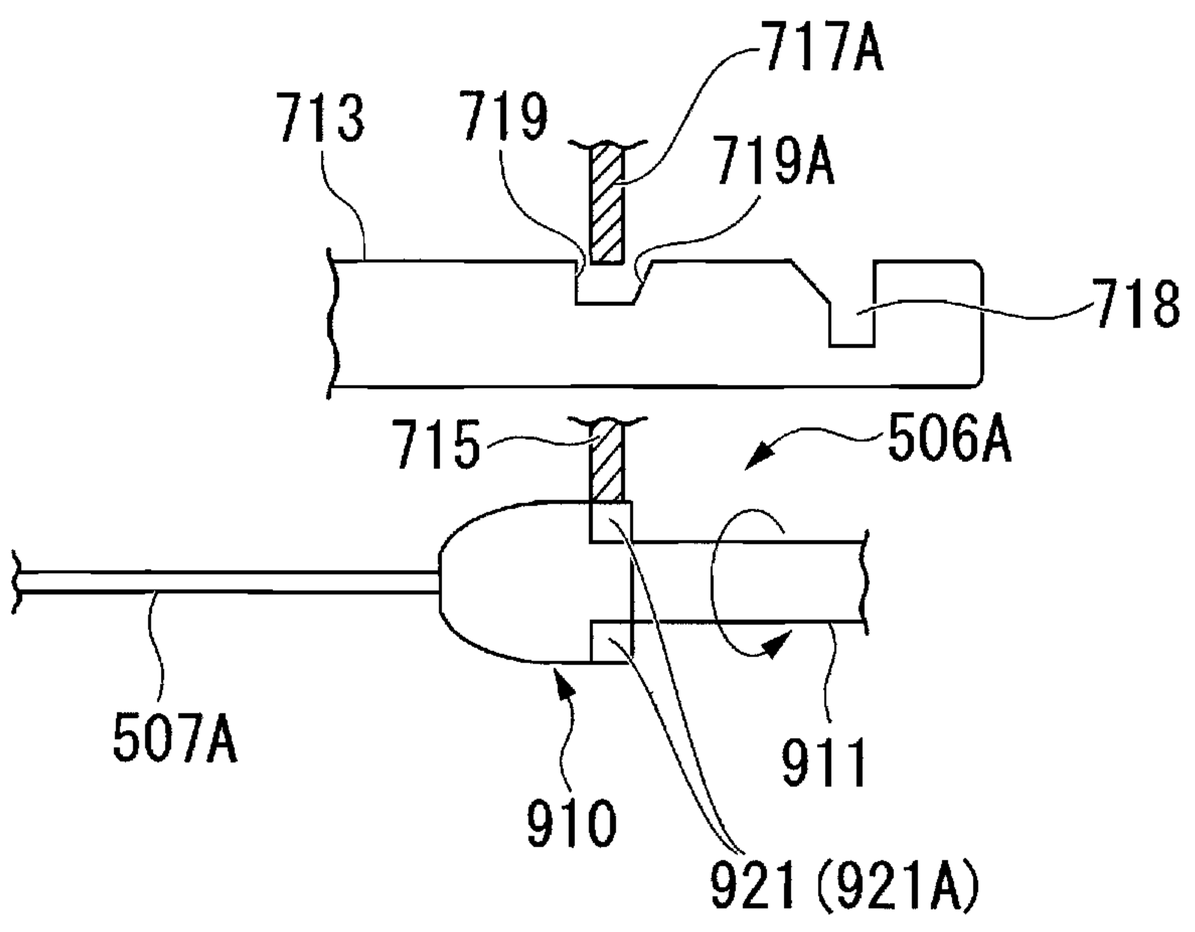

717A
713
719
719A
718
715
506A
507A
910
911

FIG. 29


717A
713
719
719A
718
715
506A
507A
910
911
921 (921A)

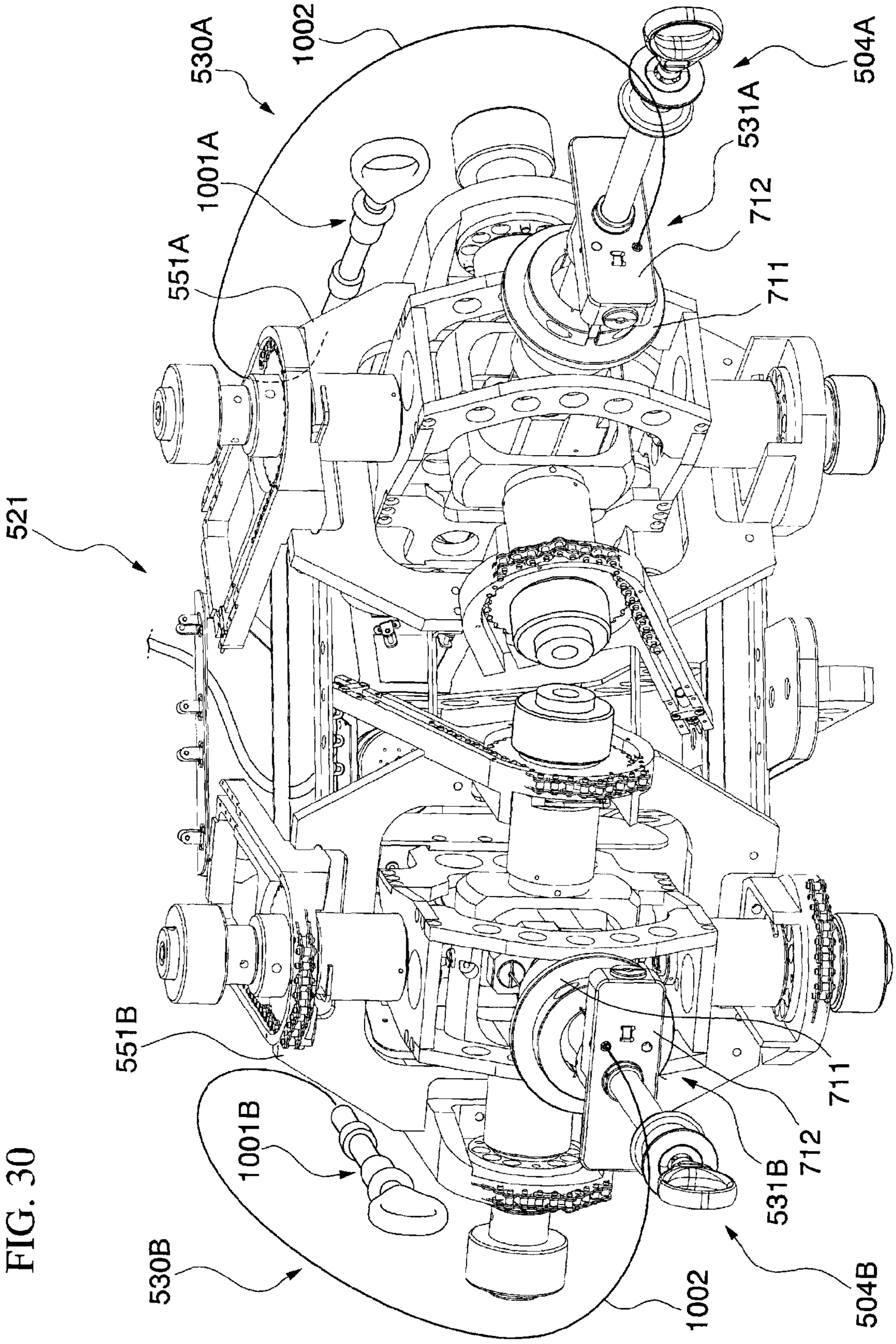

530A
1002
504A
1001A
531A
551A
712
711
521
551B
1001B
530B
531B
712
711
1002
504B

FIG. 30

FIG. 31

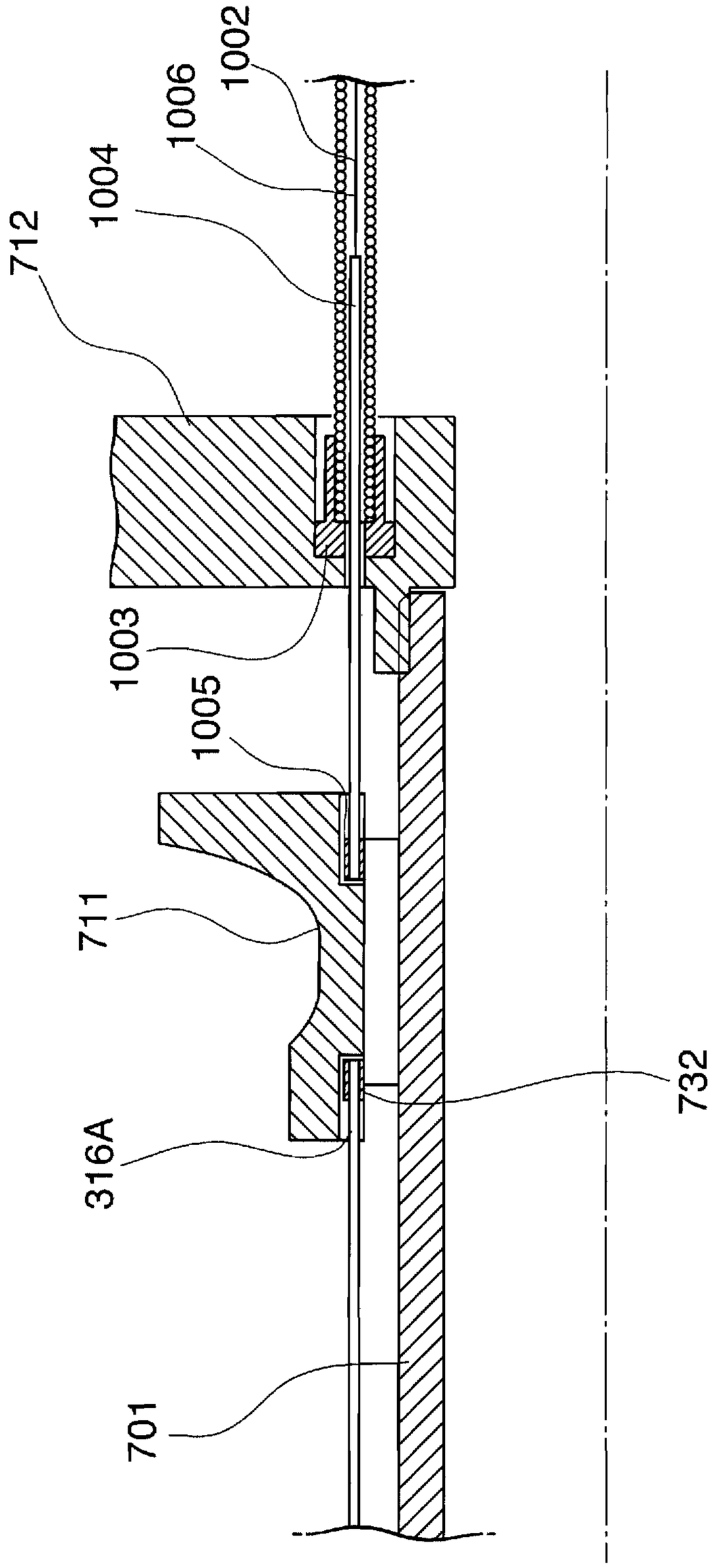


FIG. 32

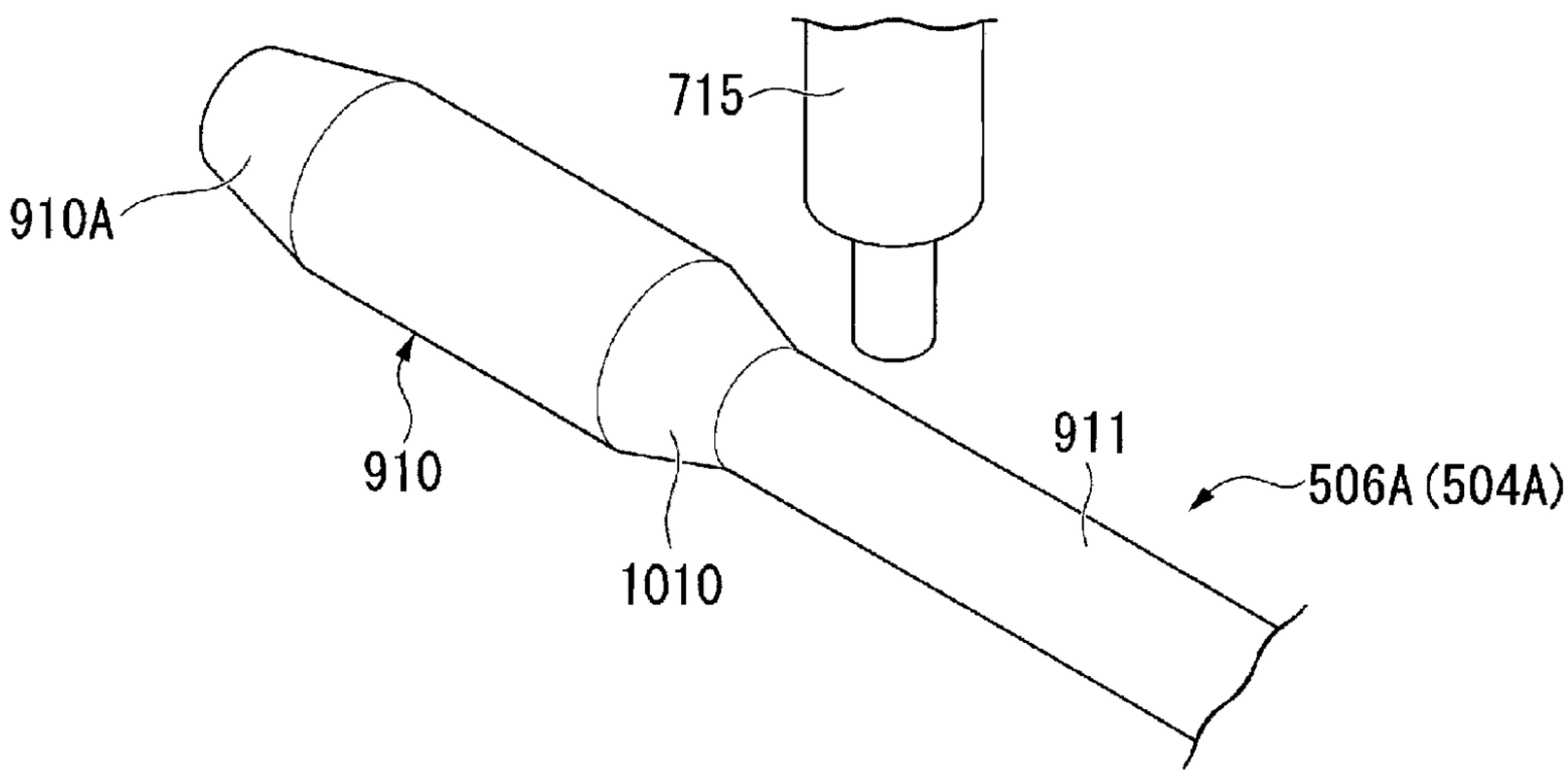


FIG. 33

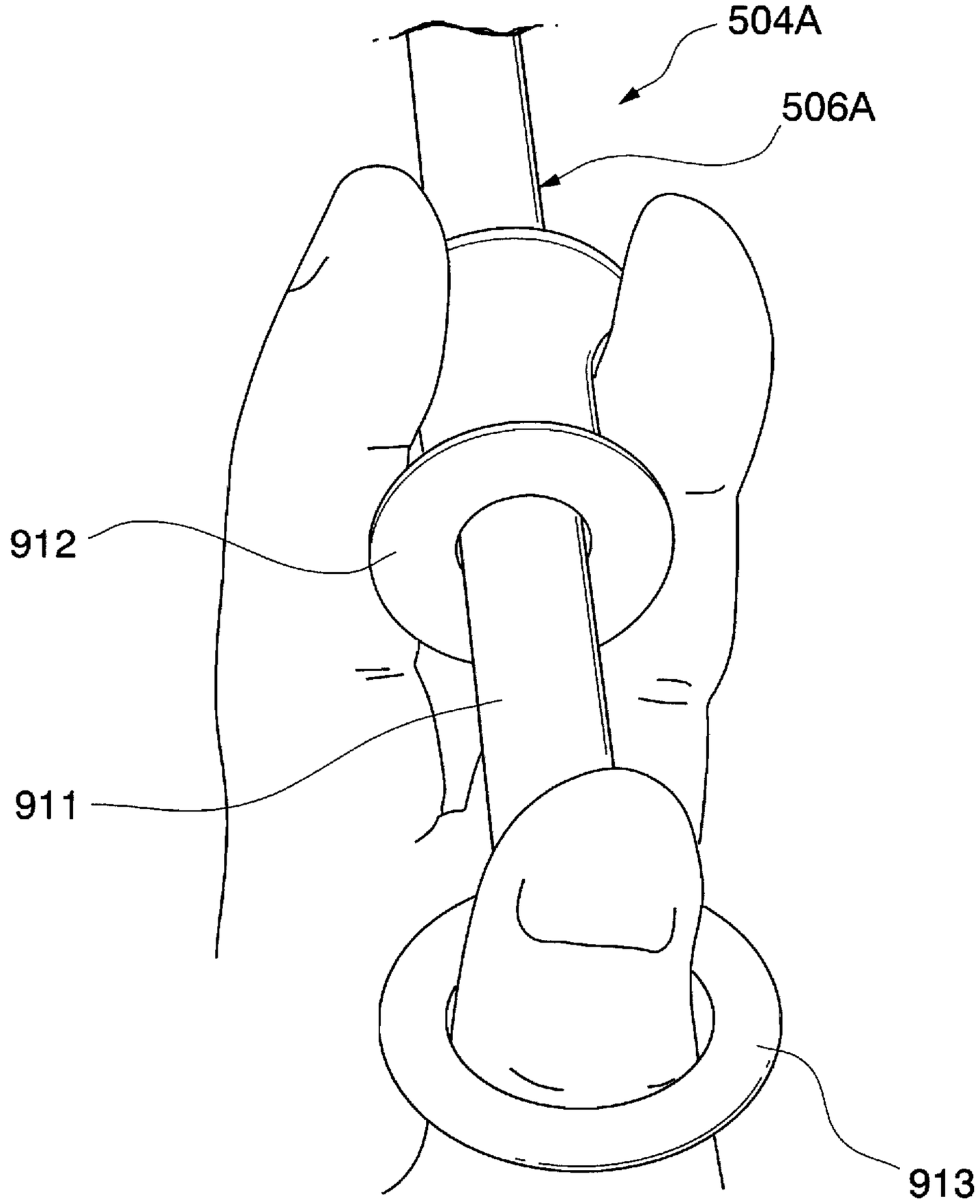


FIG. 34

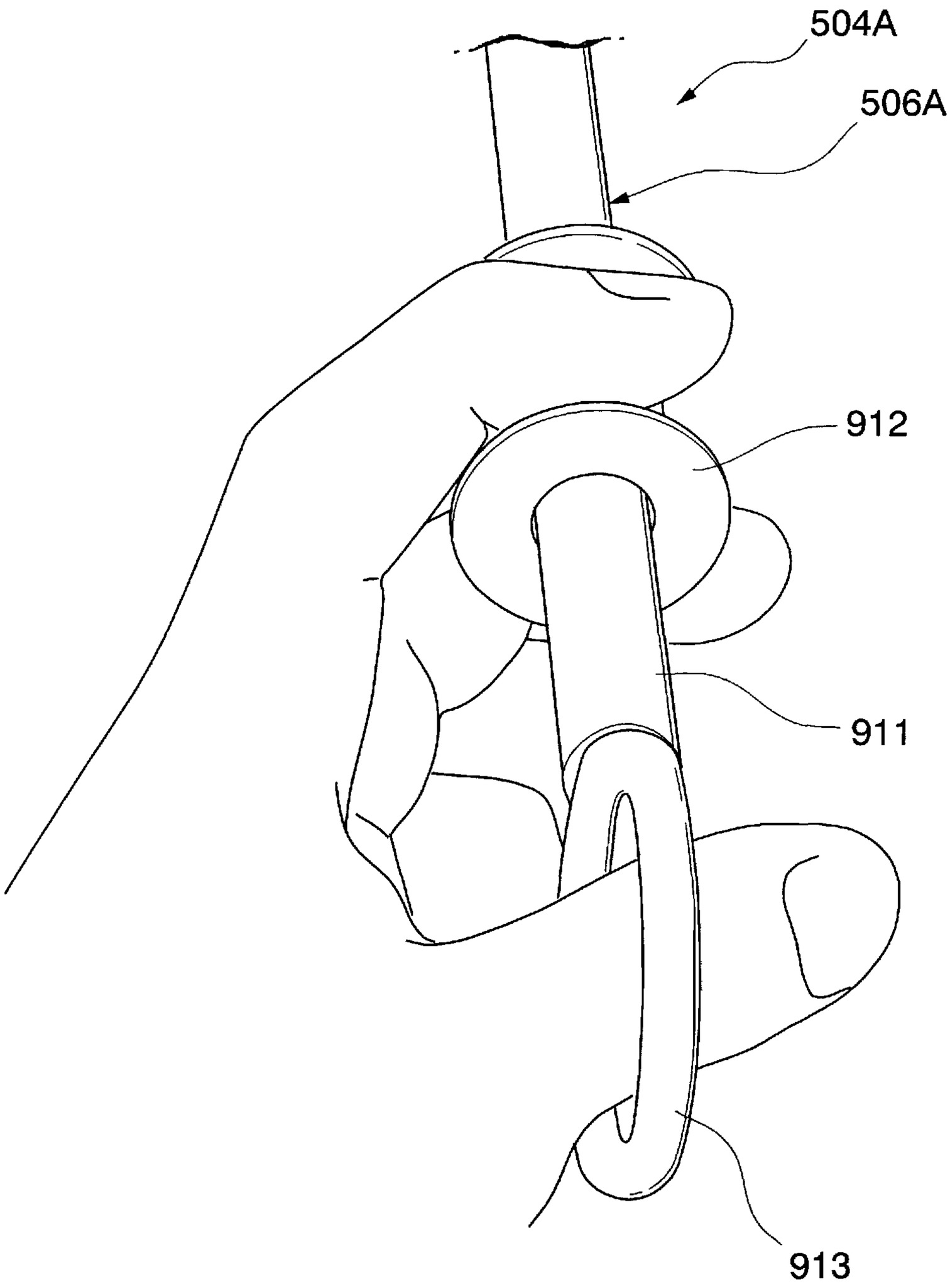
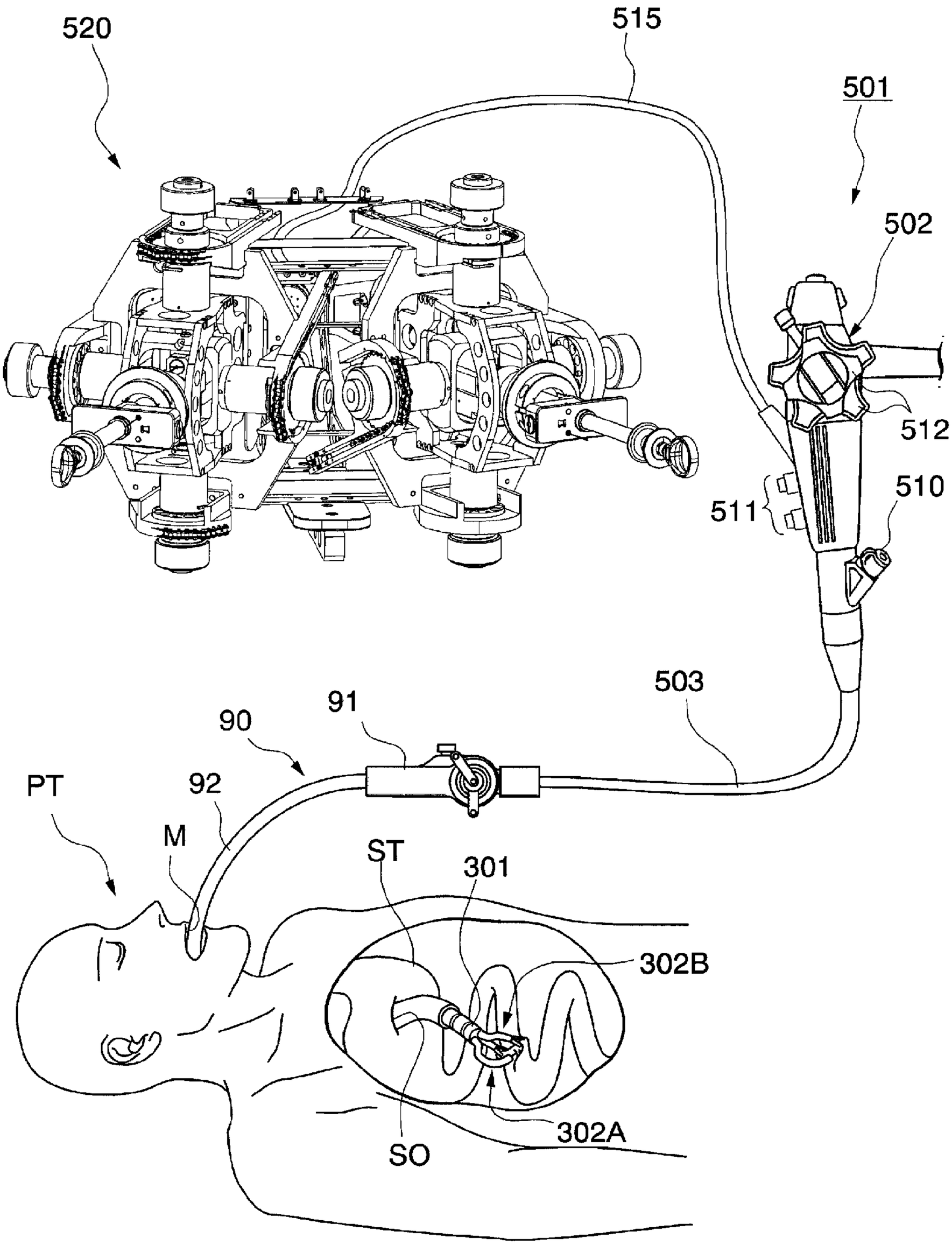


FIG. 35



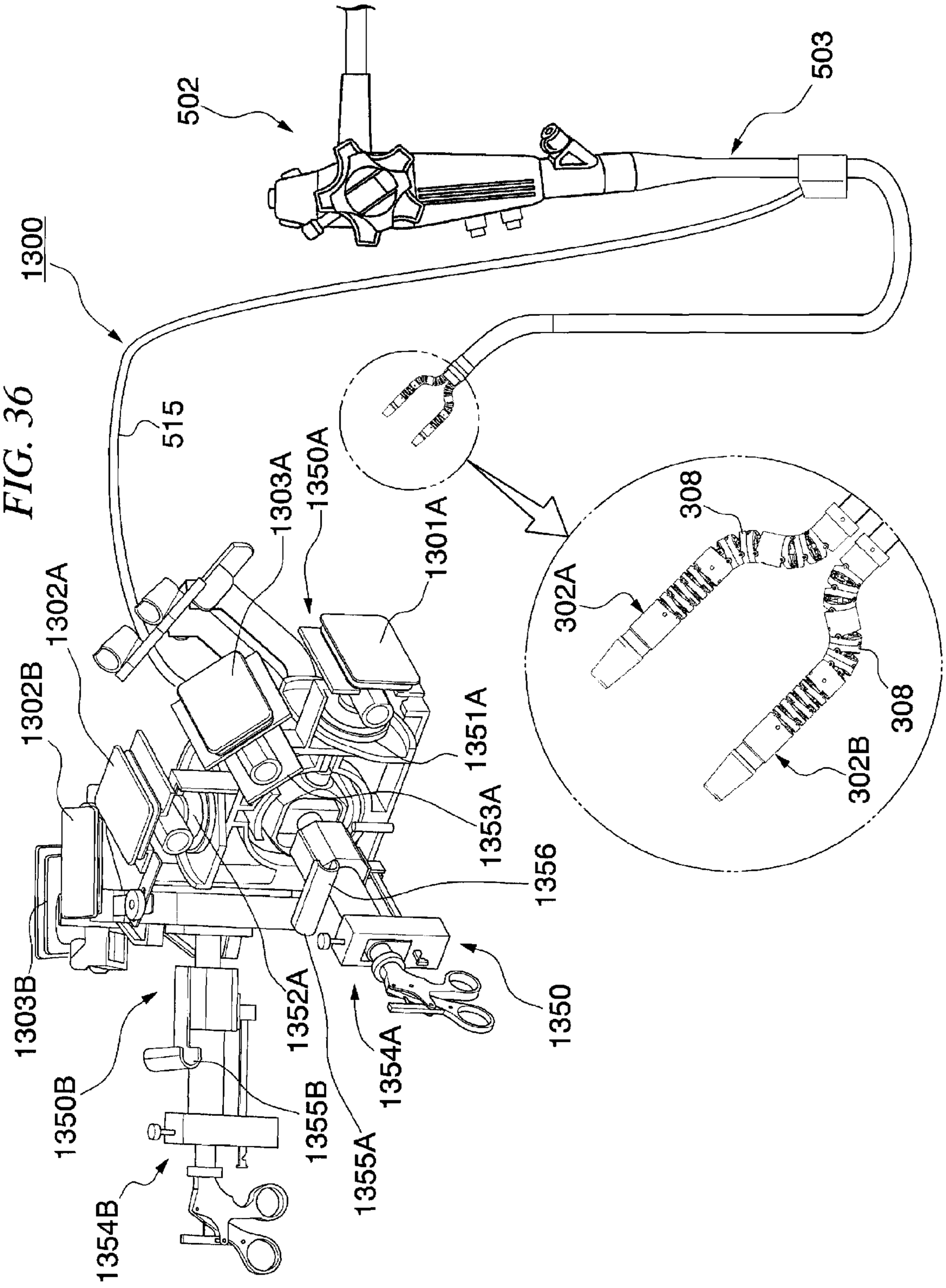

502
503
1300
515
1303A
1350A
1301A
1302A
1302B
1351A
1353A
1356
1303B
1350B
1352A
1355B
1355A
1354A
1354B
1350
308
302A
302B
308

FIG. 36

FIG. 37

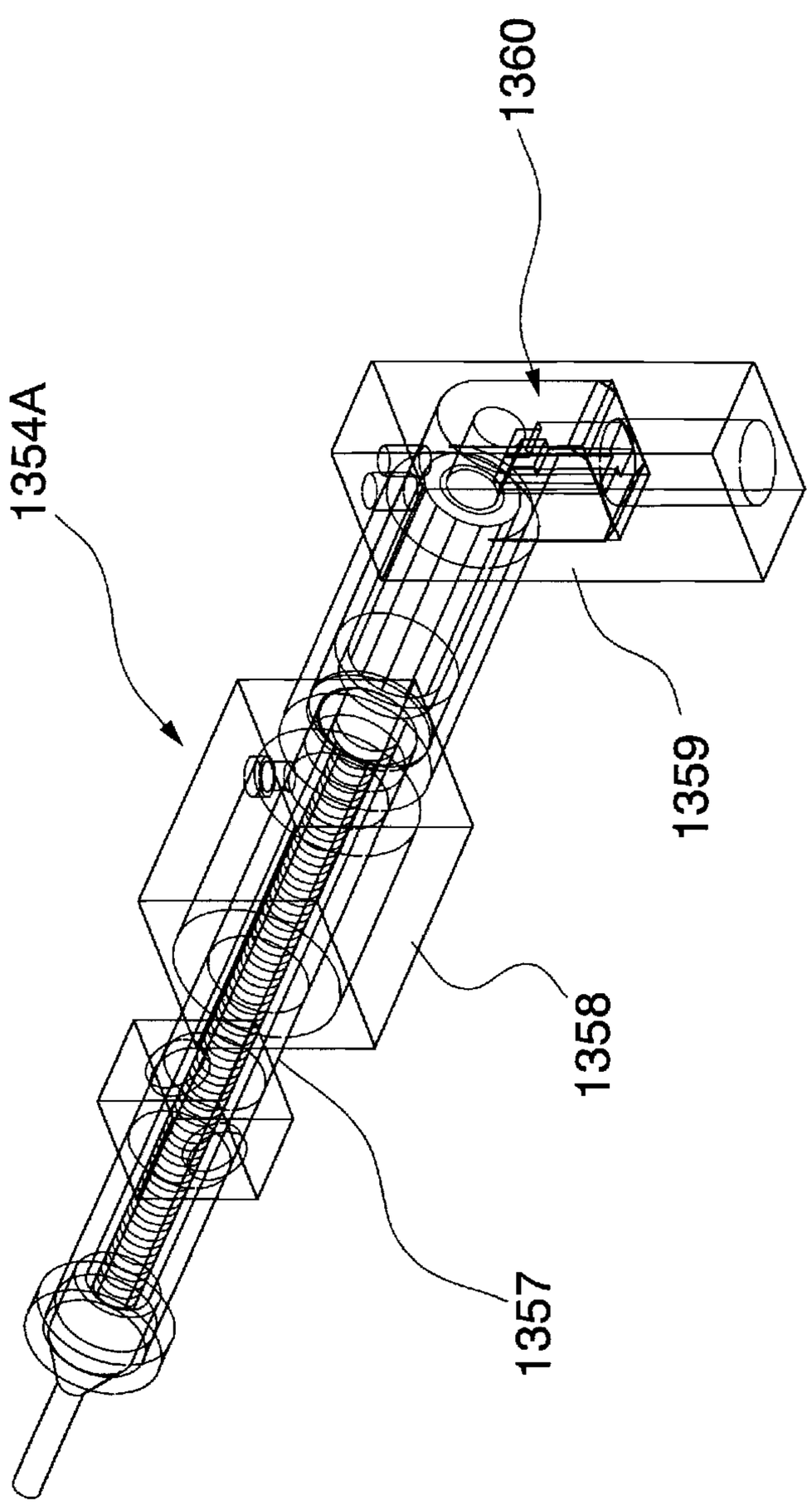
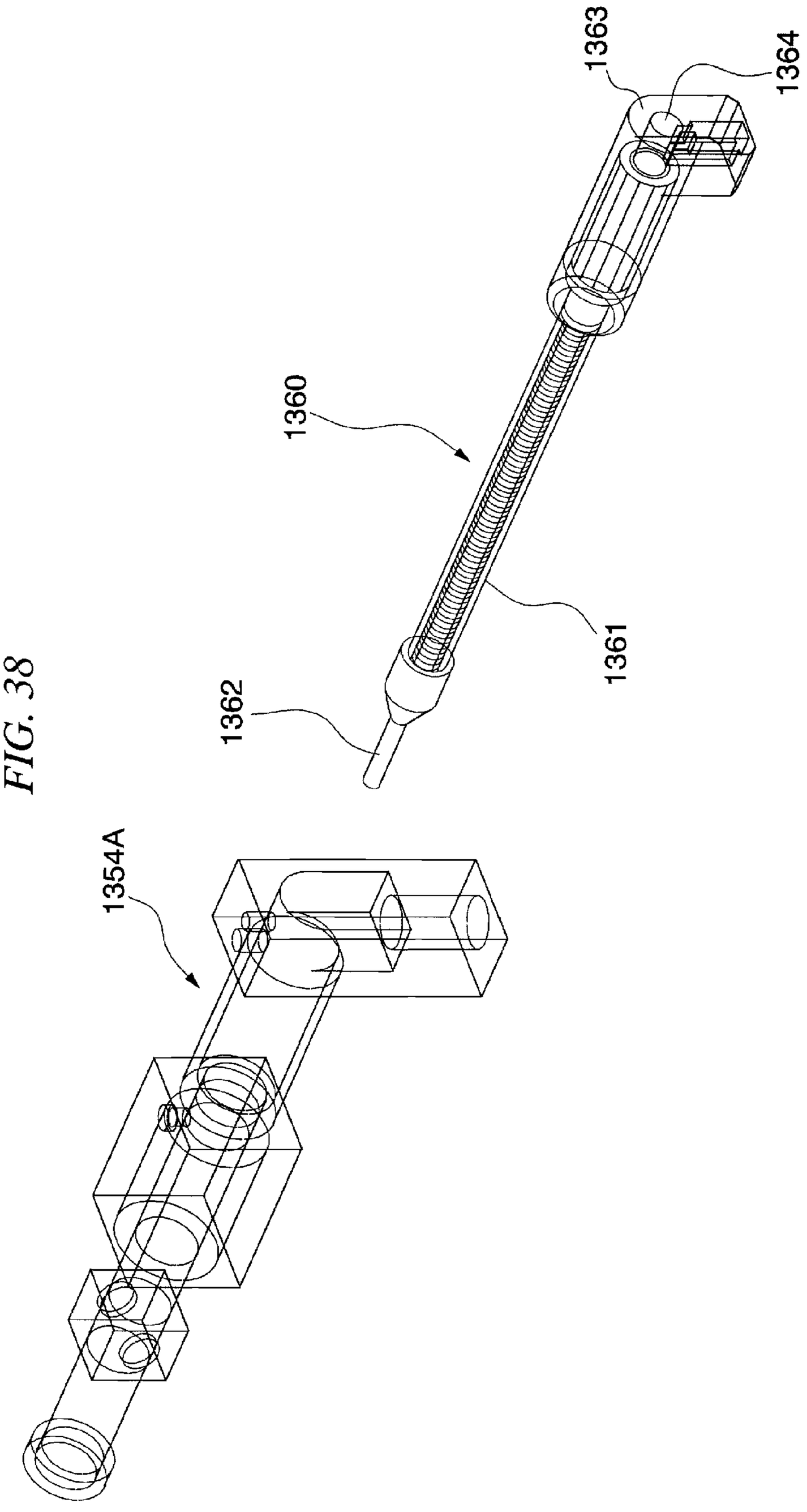
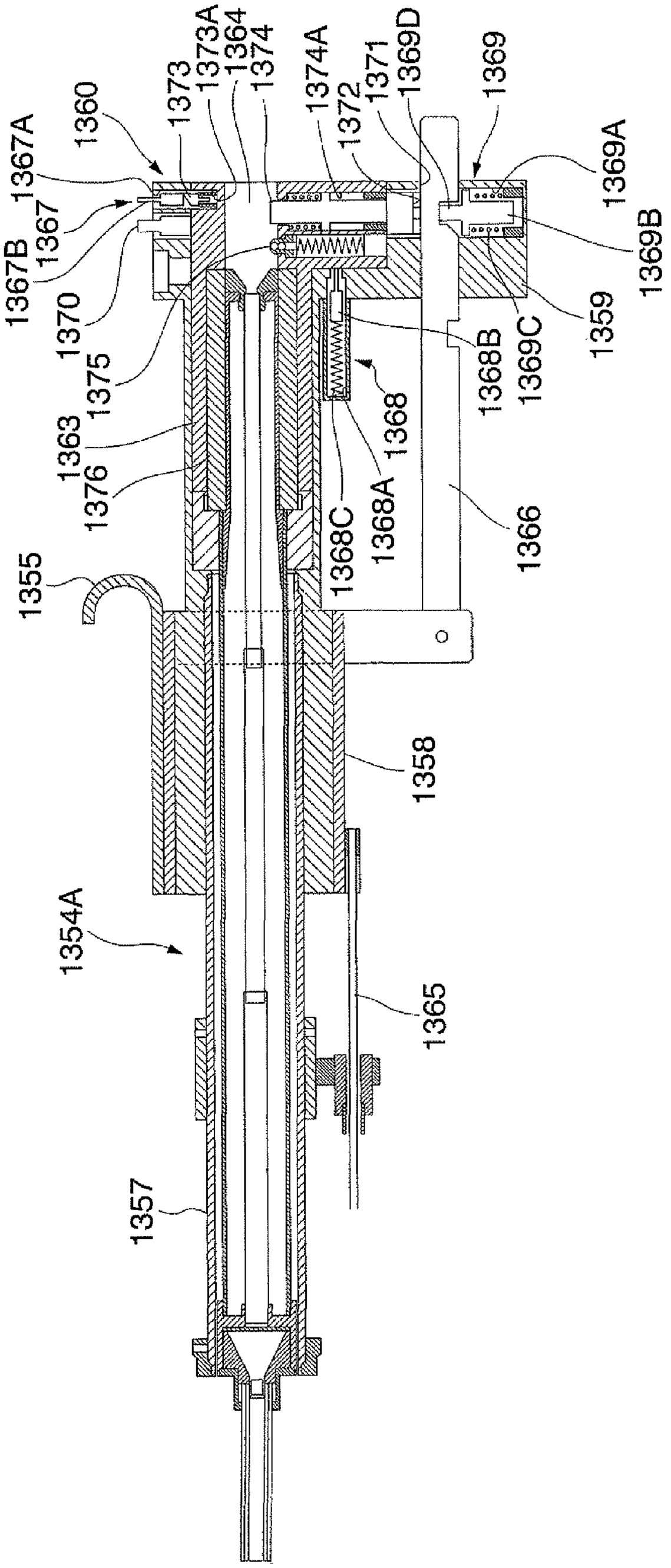


FIG. 38




1367A
1360
1373
1373A
1364
1374
1374A
1372
1371
1369D
1369
1369A
1367B
1367
1370
1375
1363
1376
1355
1354A
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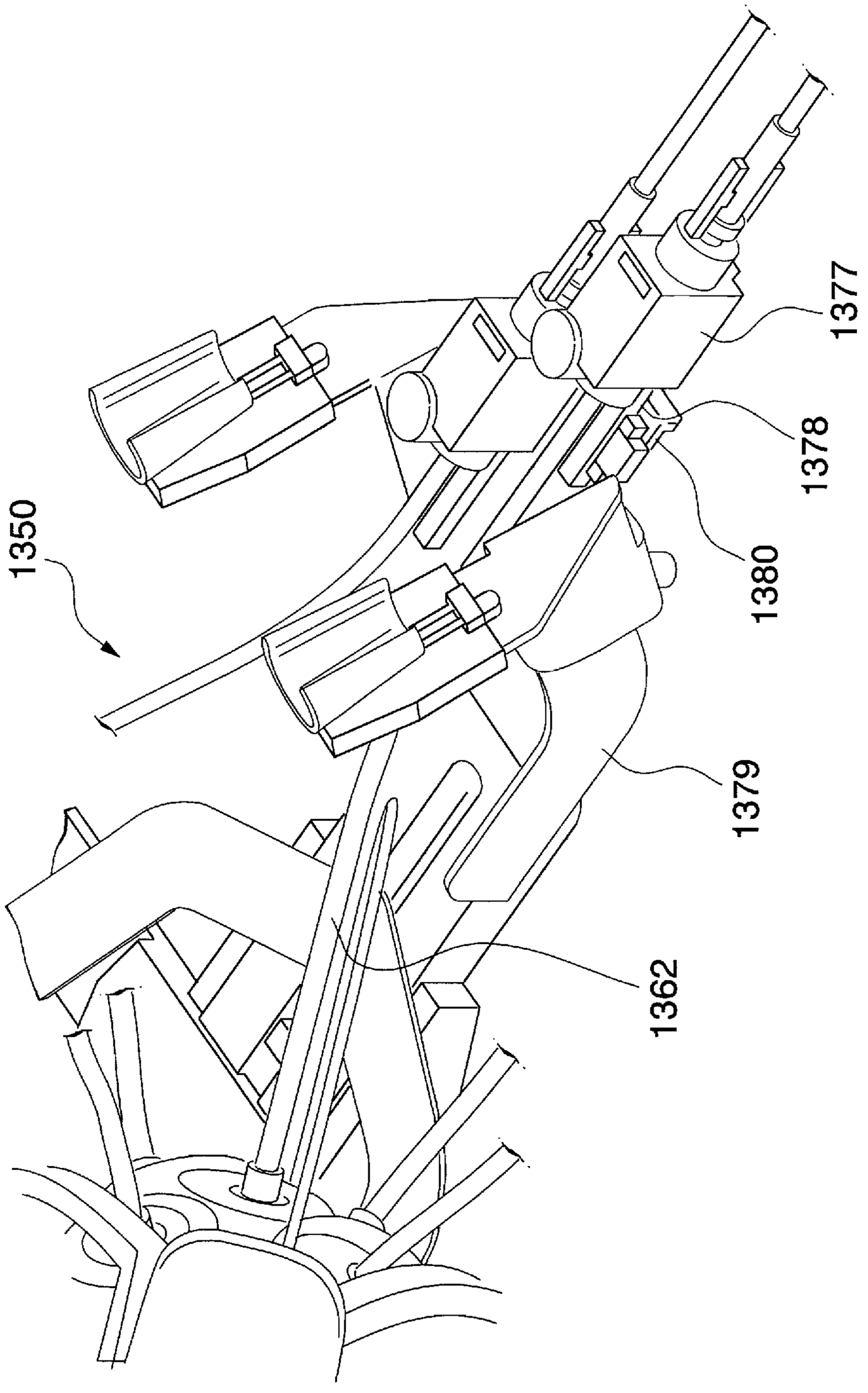
1359
1369B
1368B
1369C
1368
1368C
1368A
1366
1358
1365

FIG. 39

FIG. 40



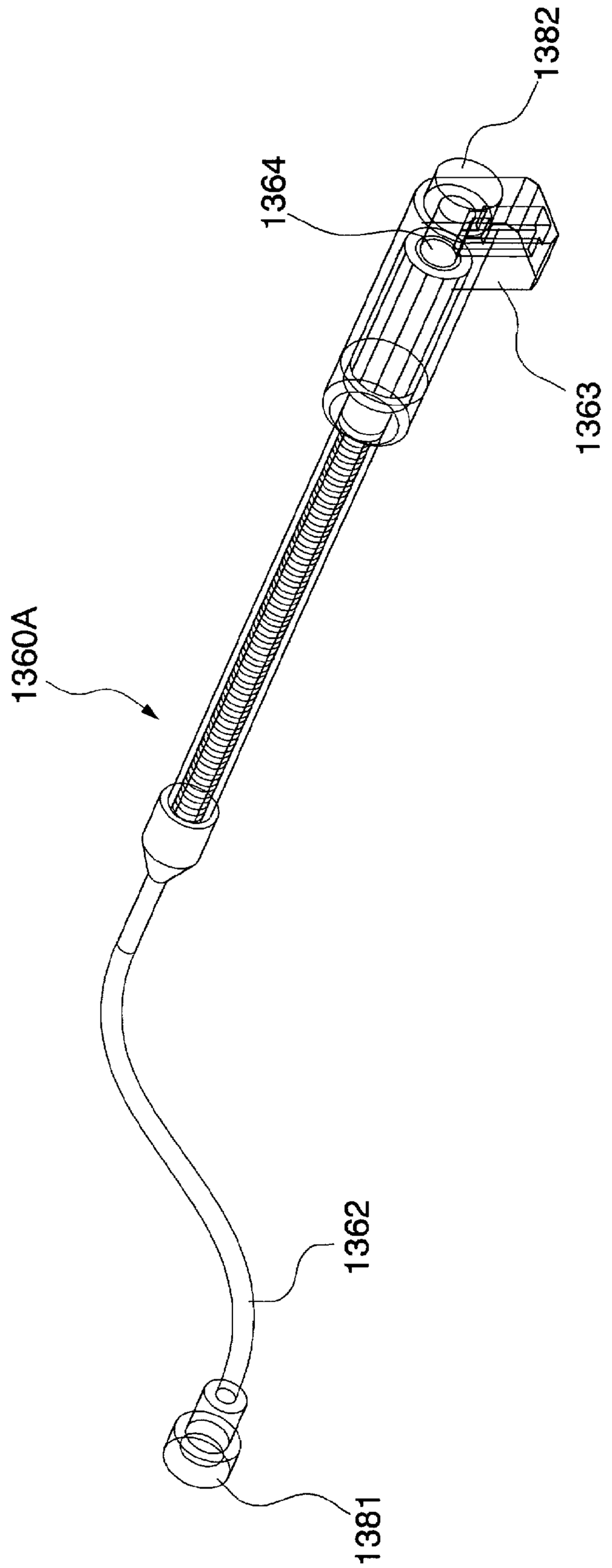


FIG. 41

FIG. 42

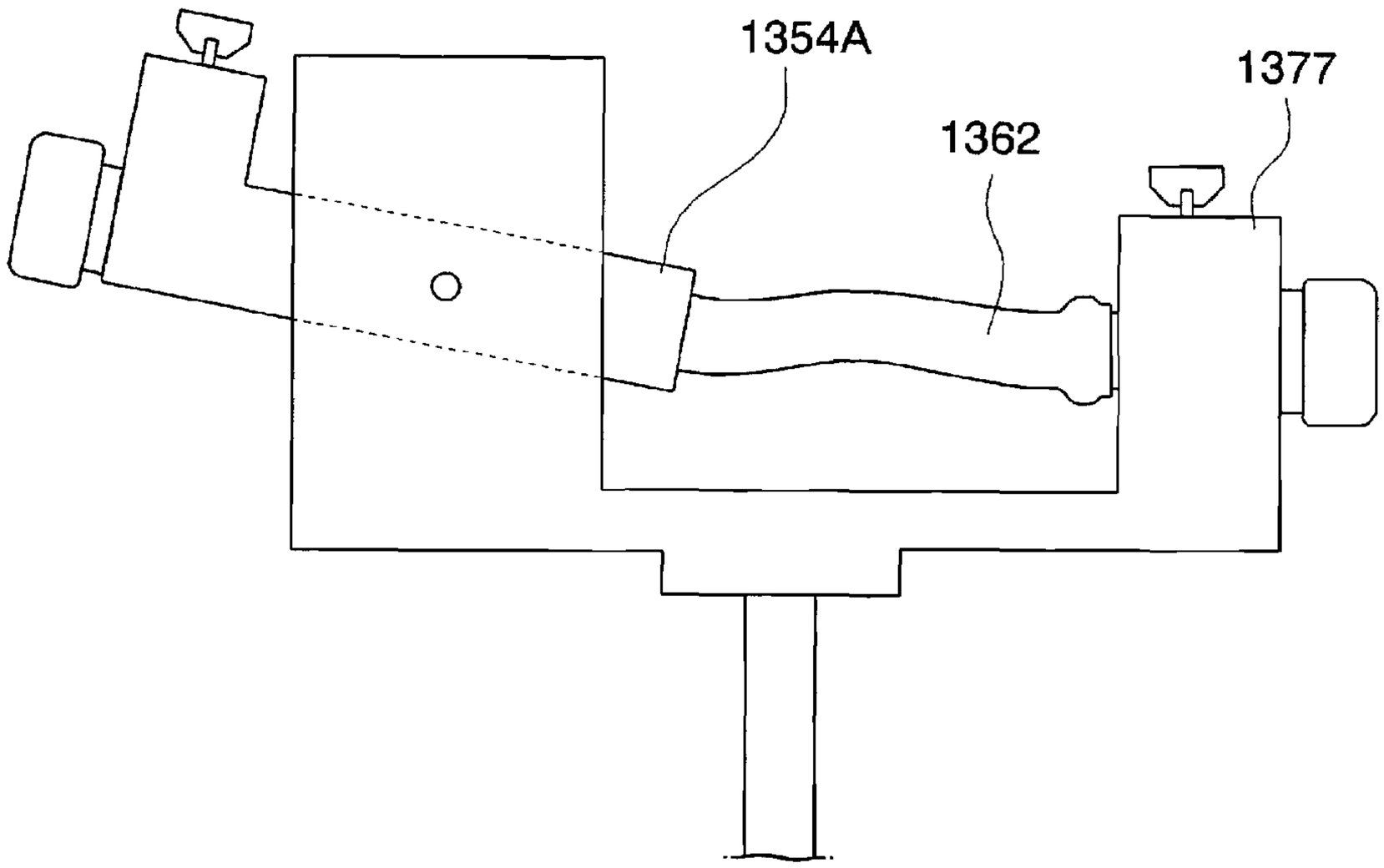


FIG. 43

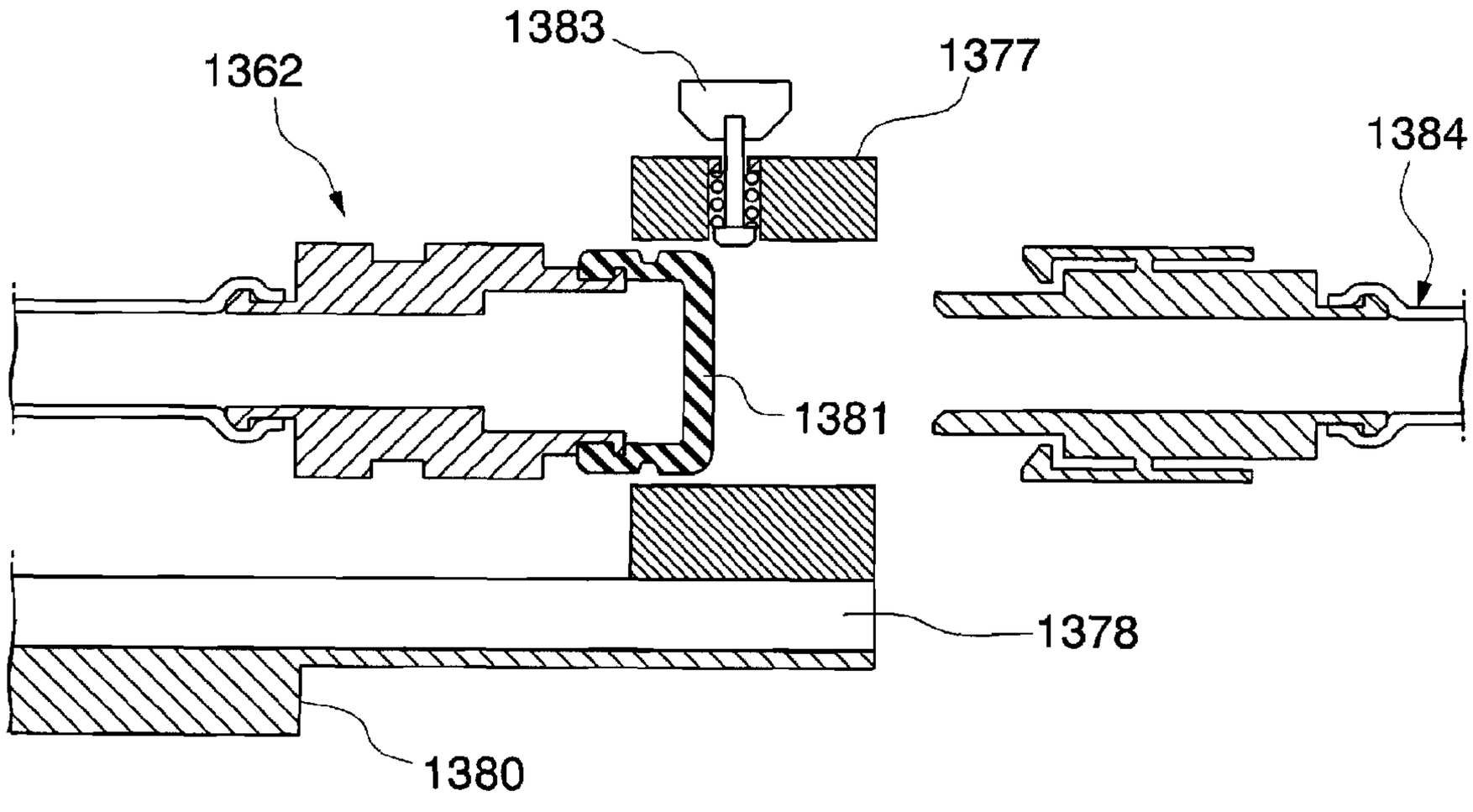


FIG. 44

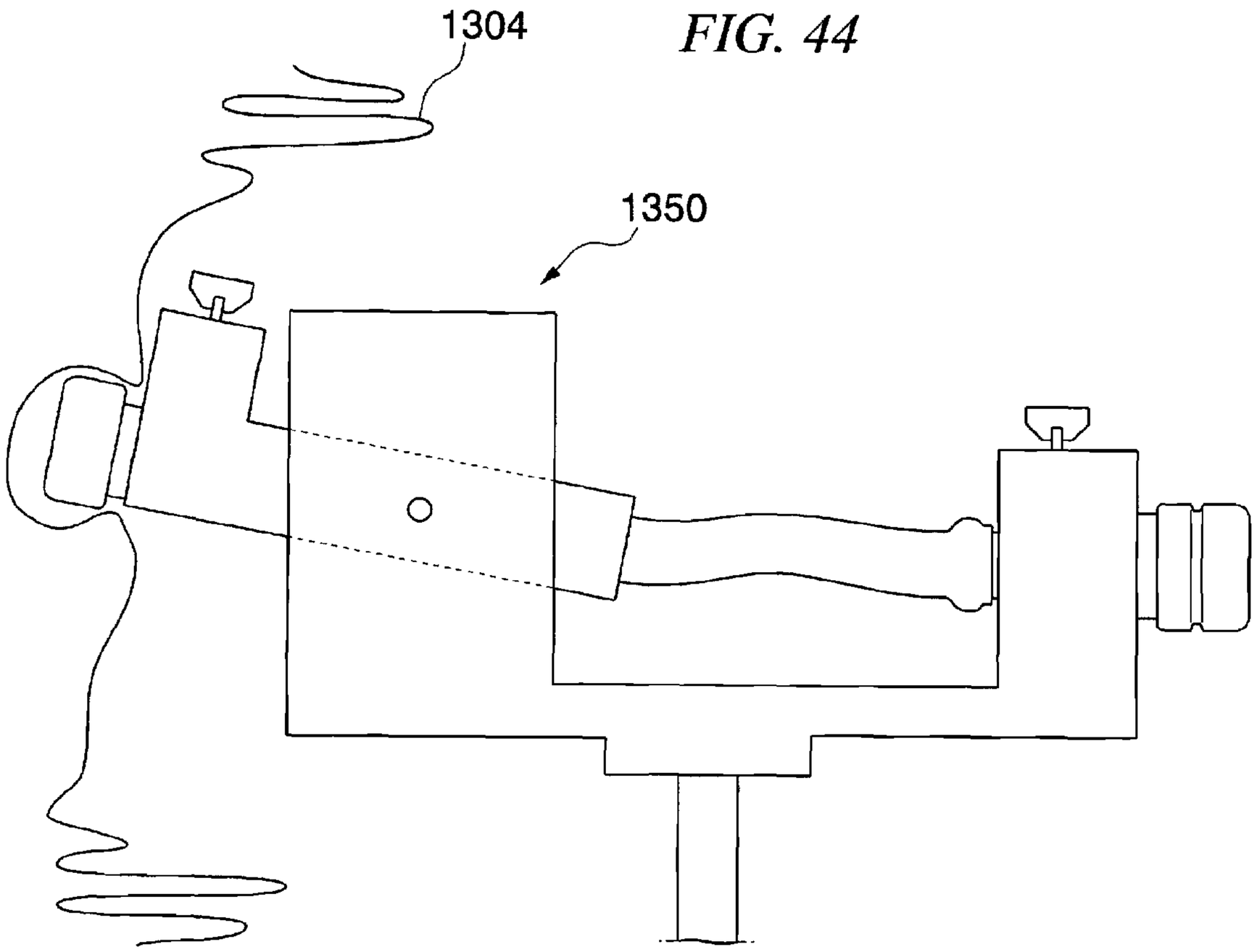


FIG. 45

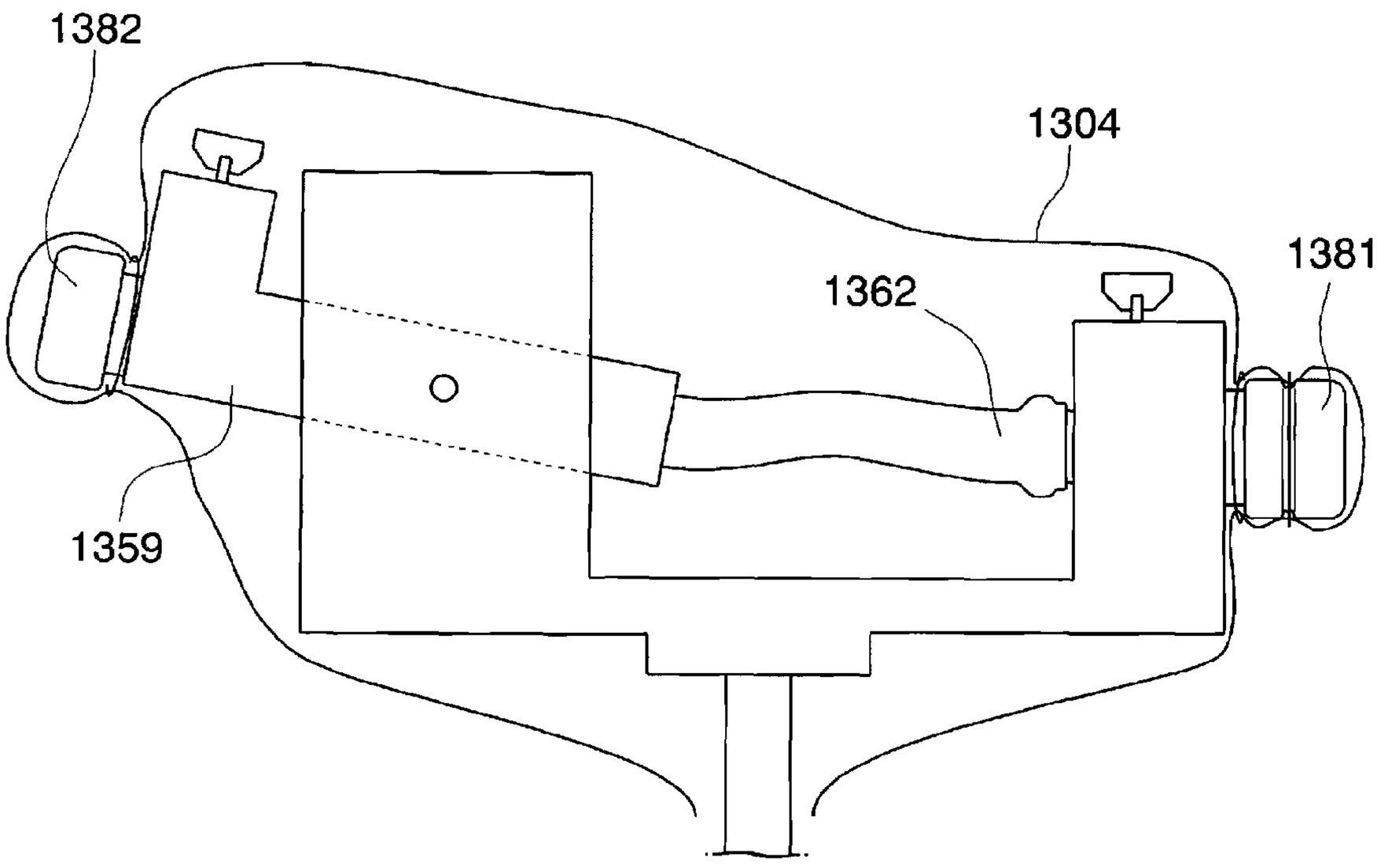


FIG. 46

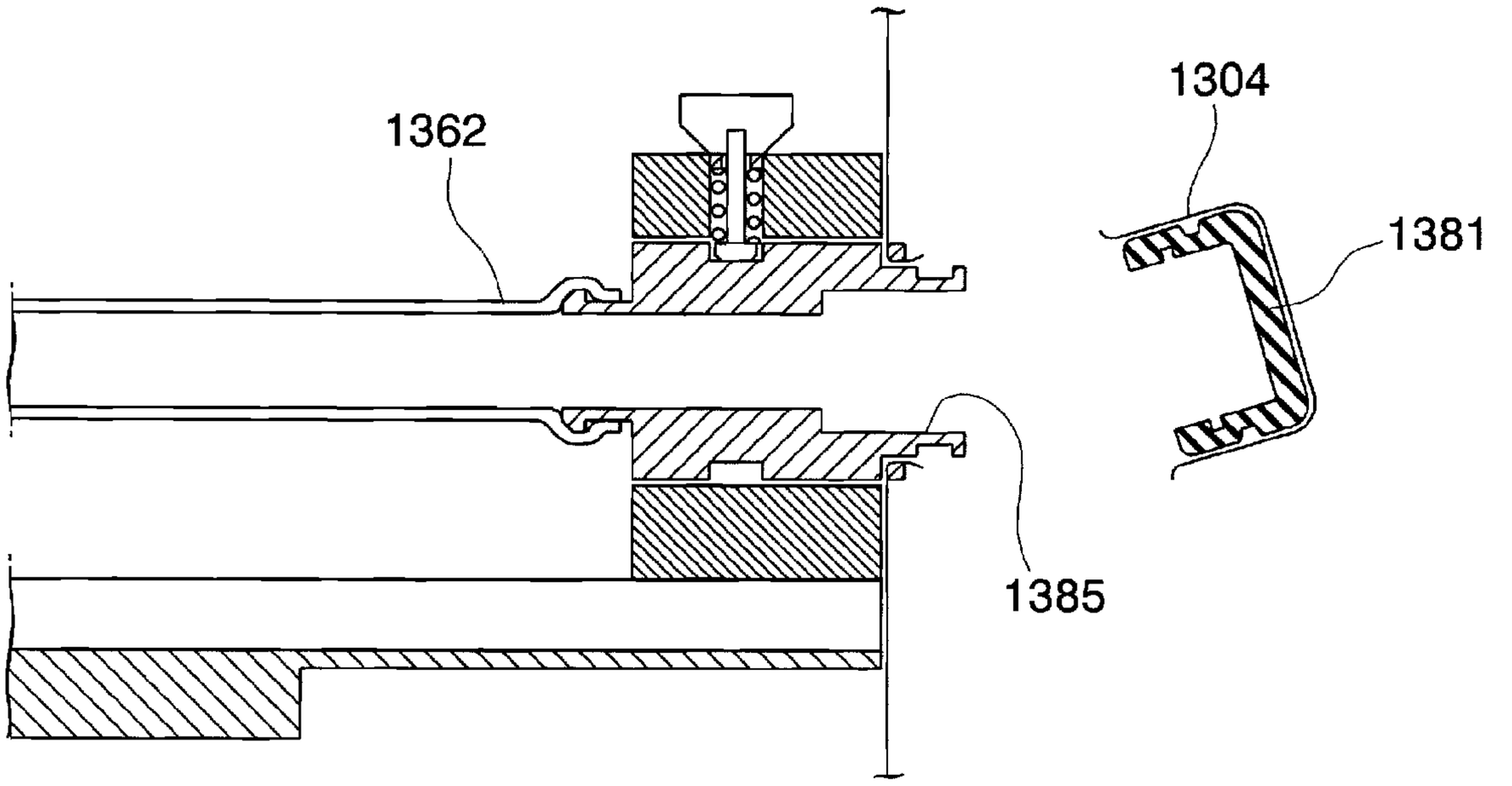

1362
1304
1381
1385

FIG. 47

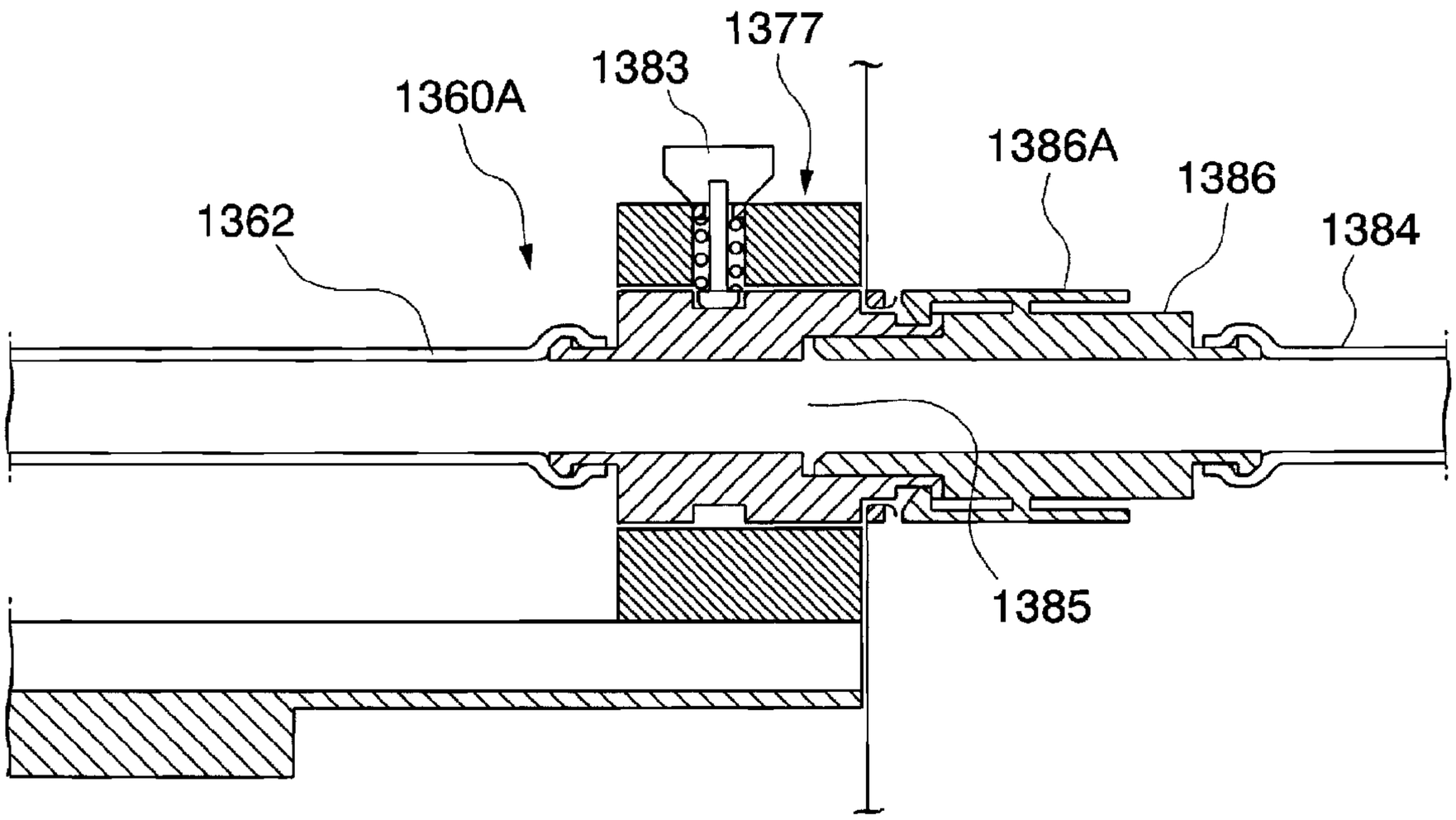

1377
1383
1360A
1386A
1386
1384
1362
1385

FIG. 48

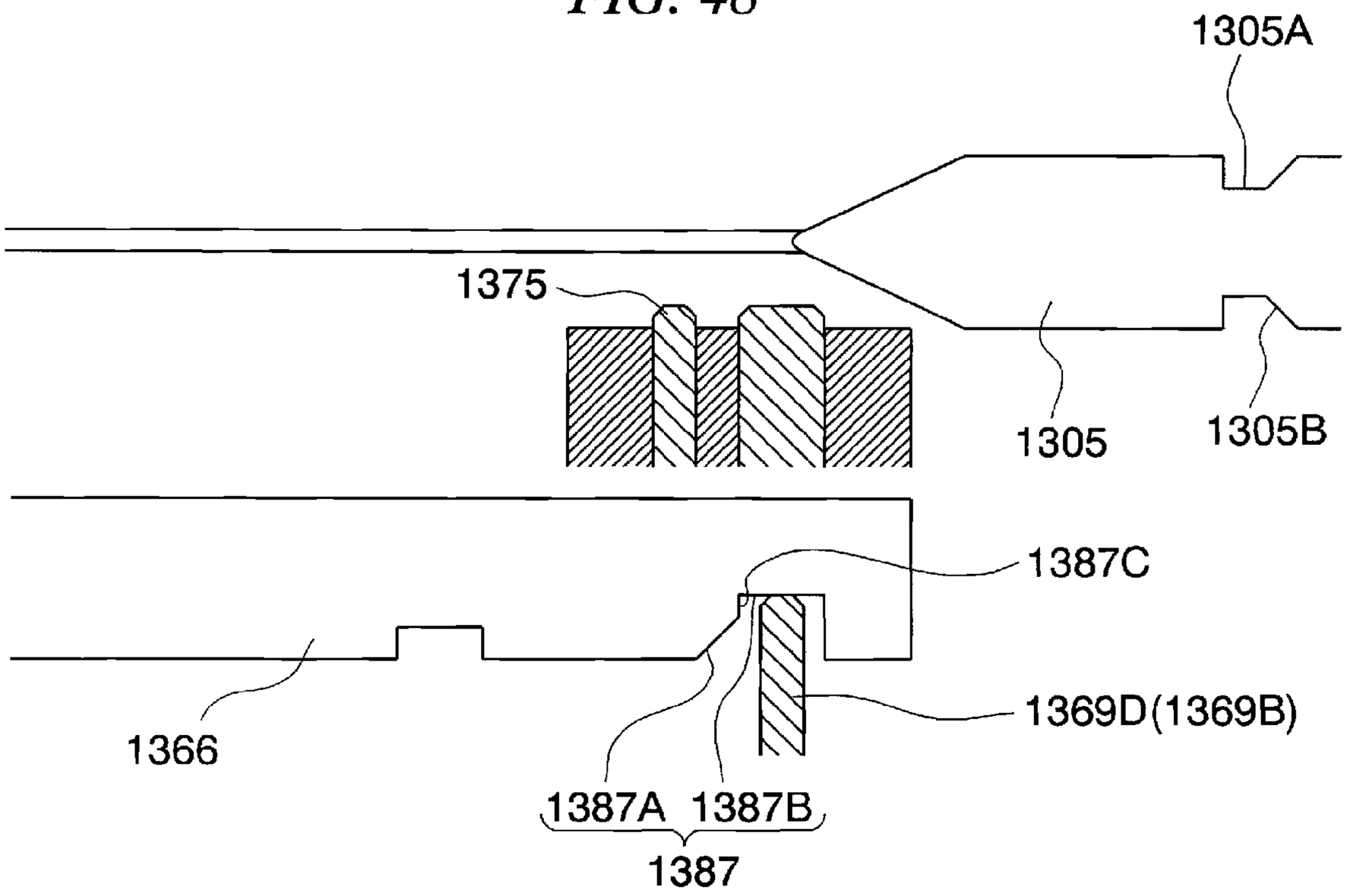

1305A
1375
1305
1305B
1387C
1369D(1369B)
1366
1387A
1387B
1387

FIG. 49

1305
1305A
1375
1374
1387C
1369D
1366
1387A

FIG. 50

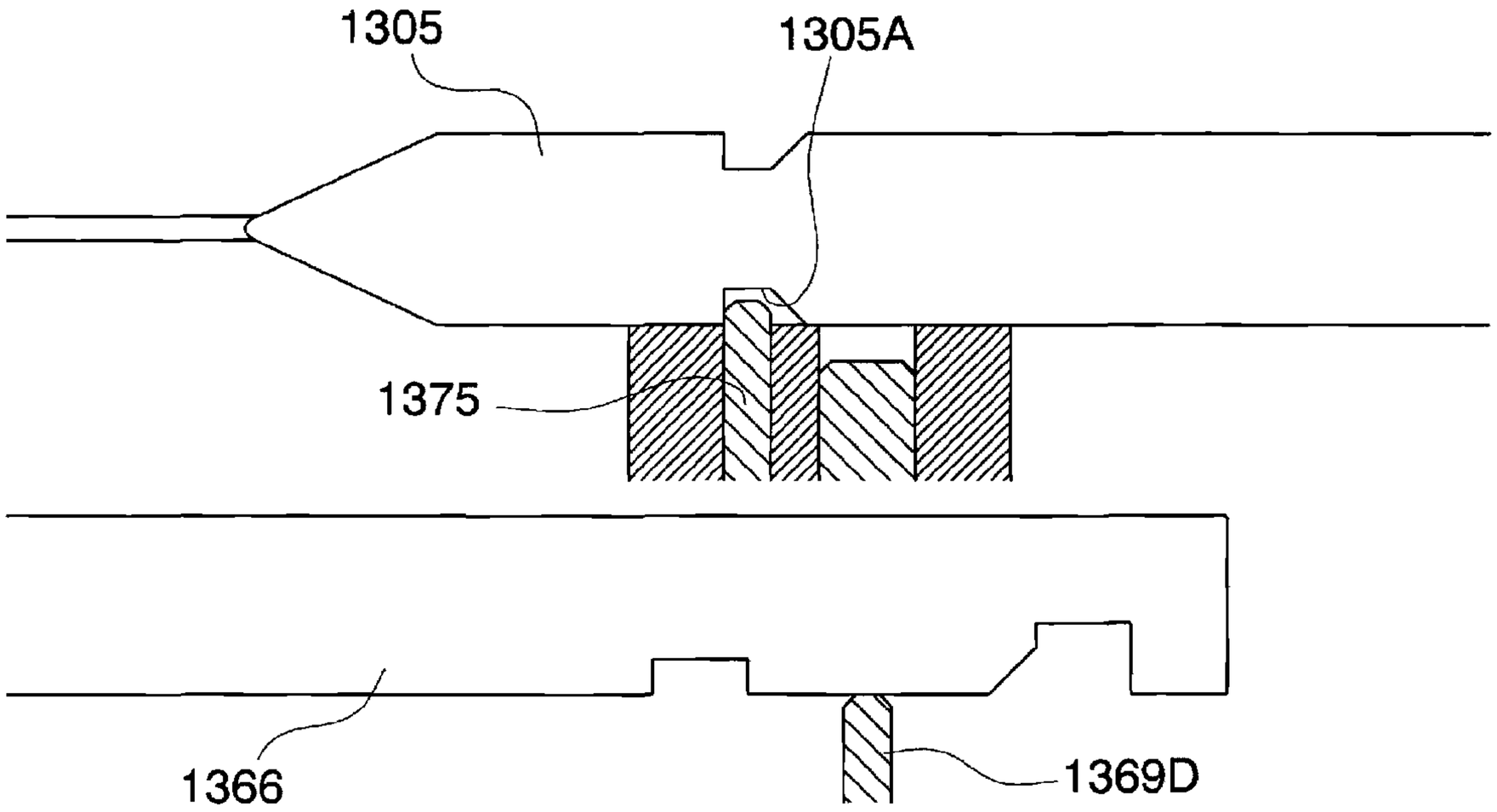


FIG. 51

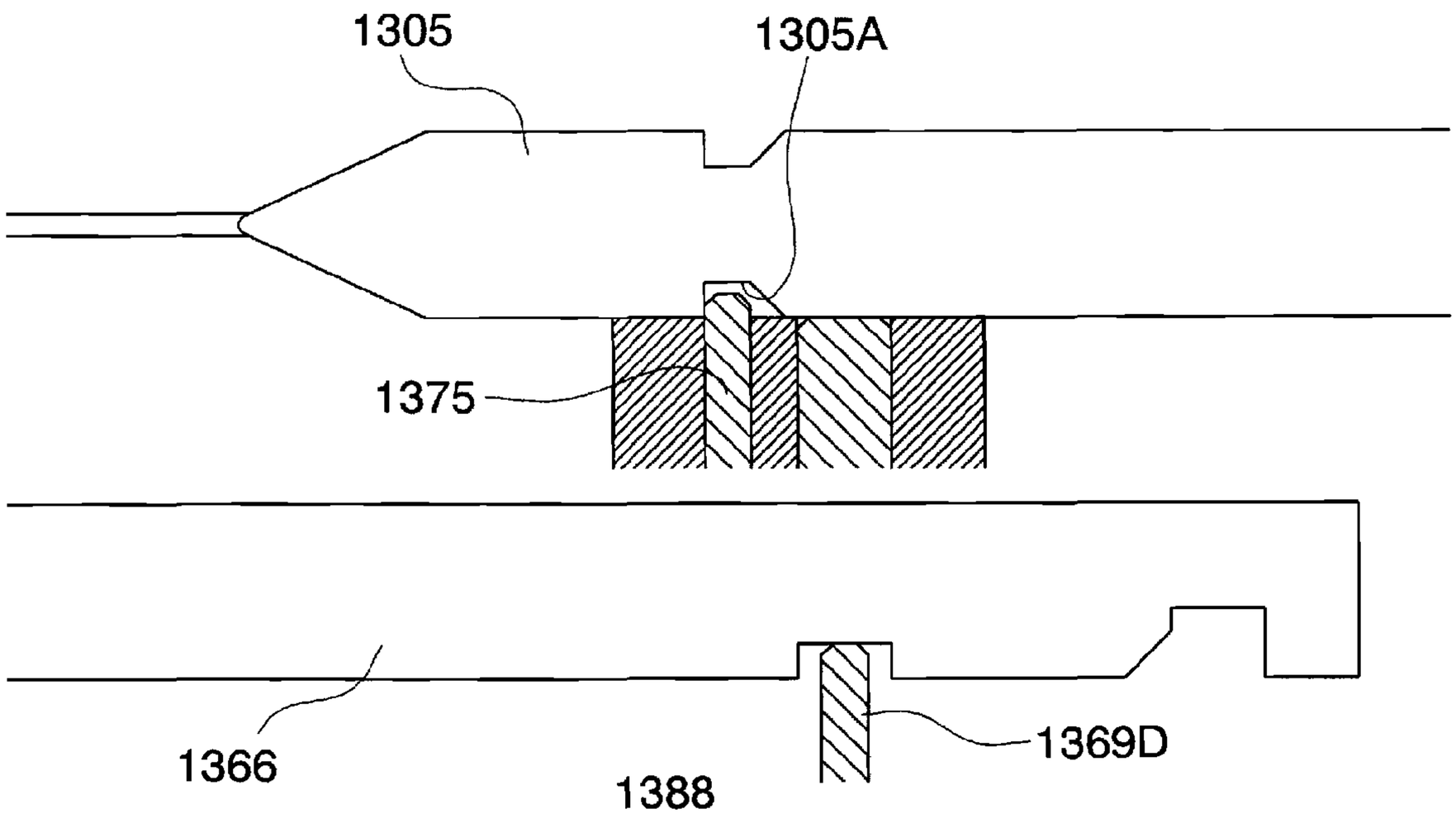


FIG. 52

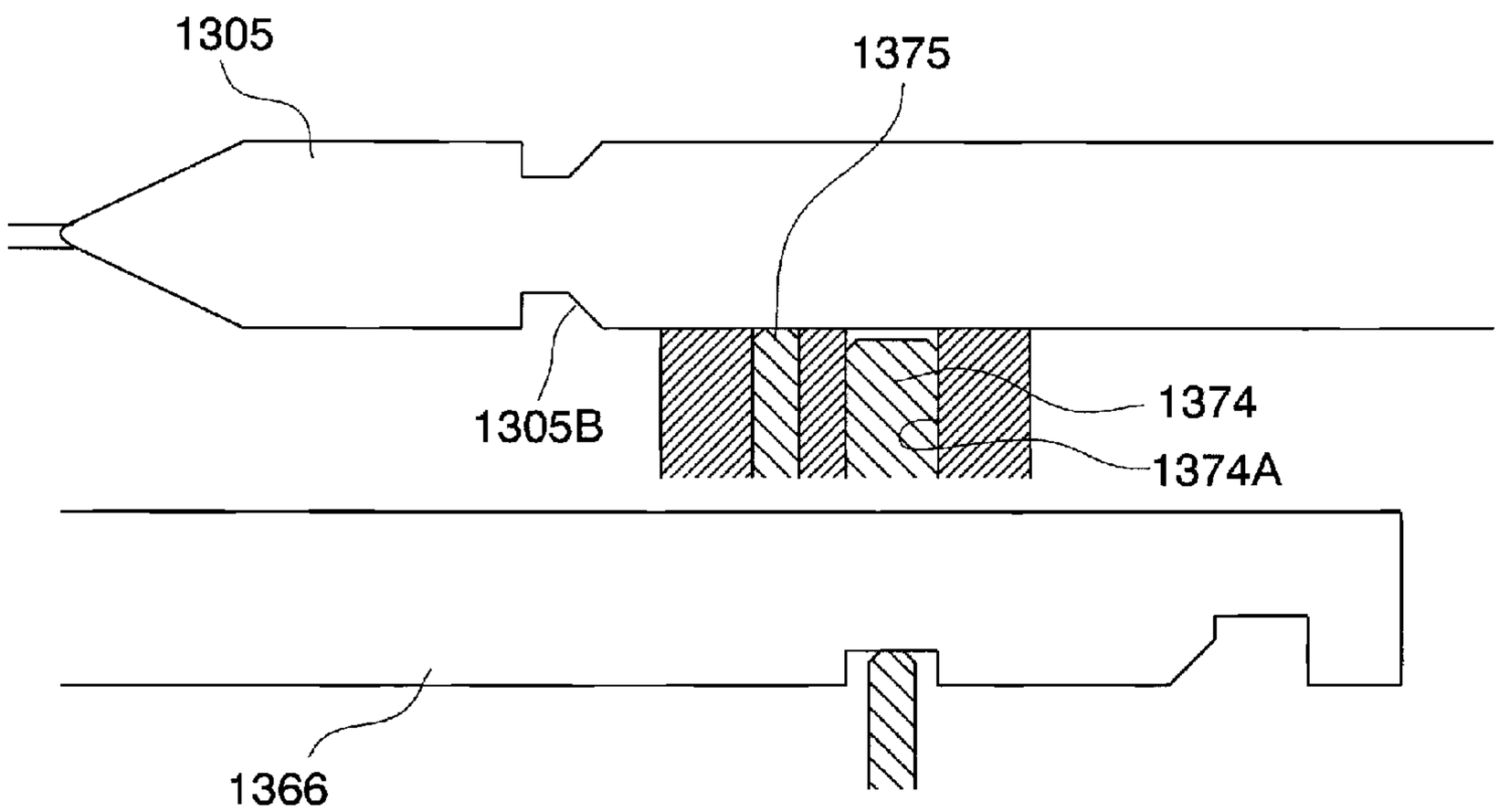


FIG. 53

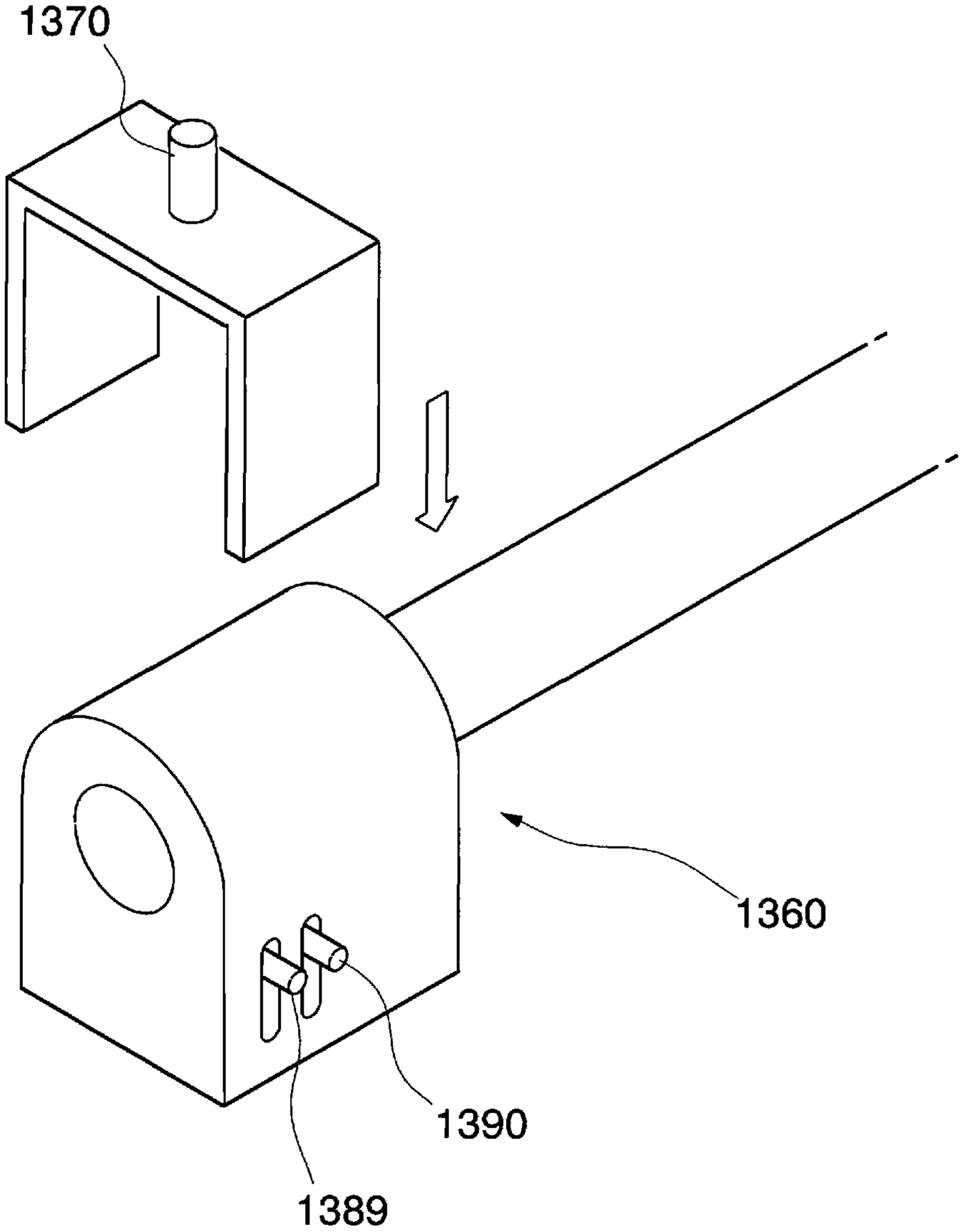
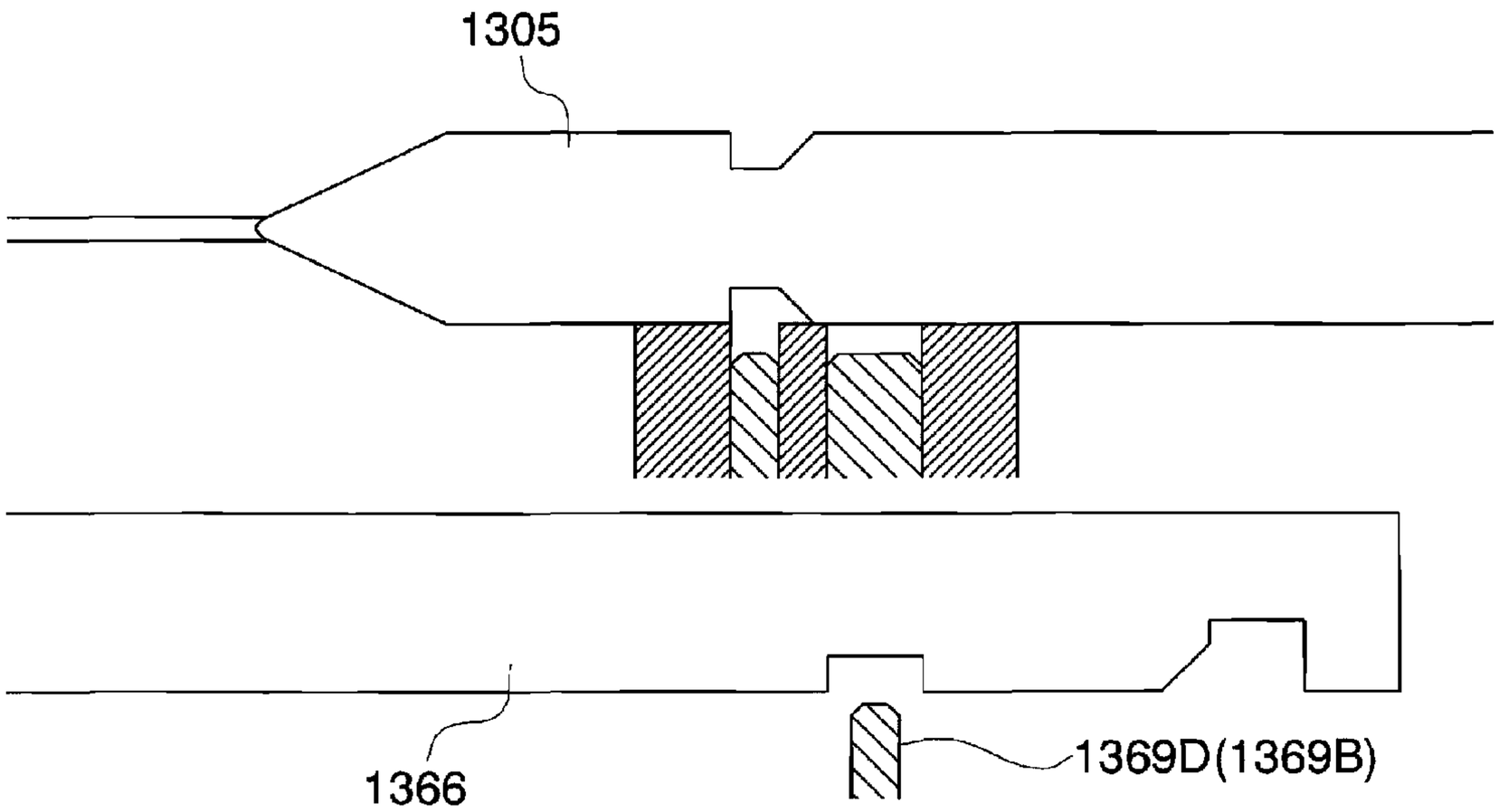


FIG. 54



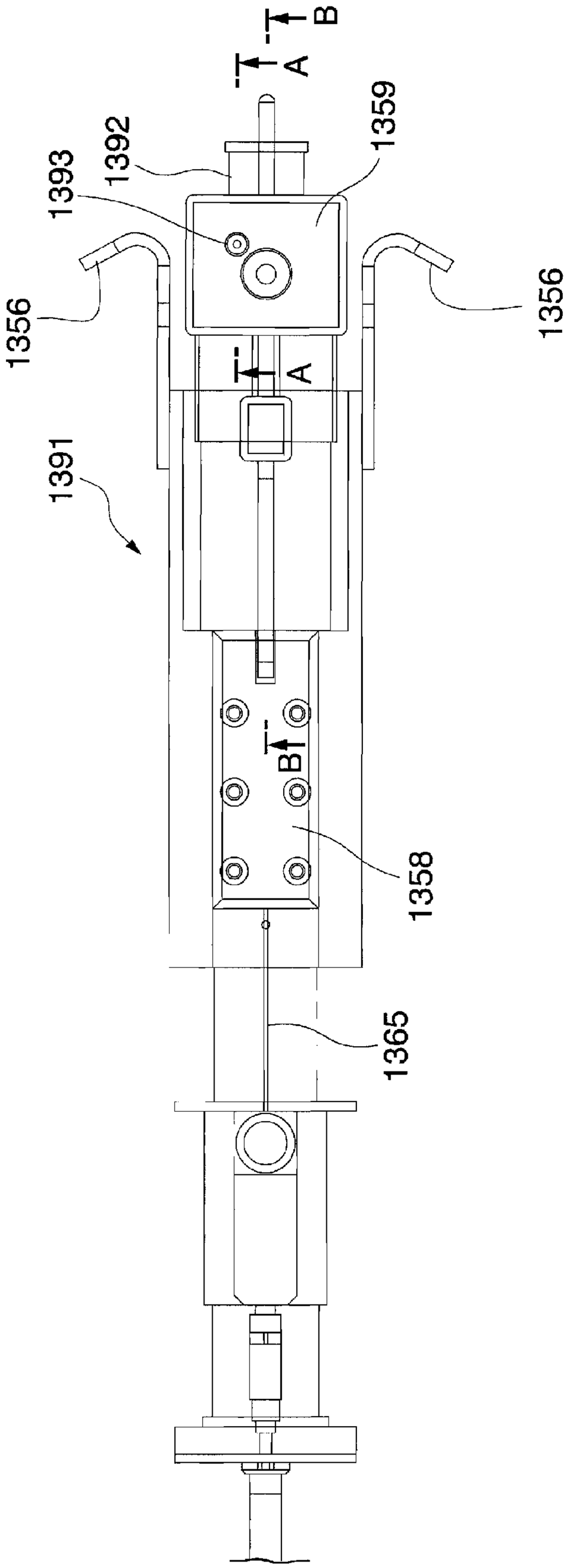


FIG. 55

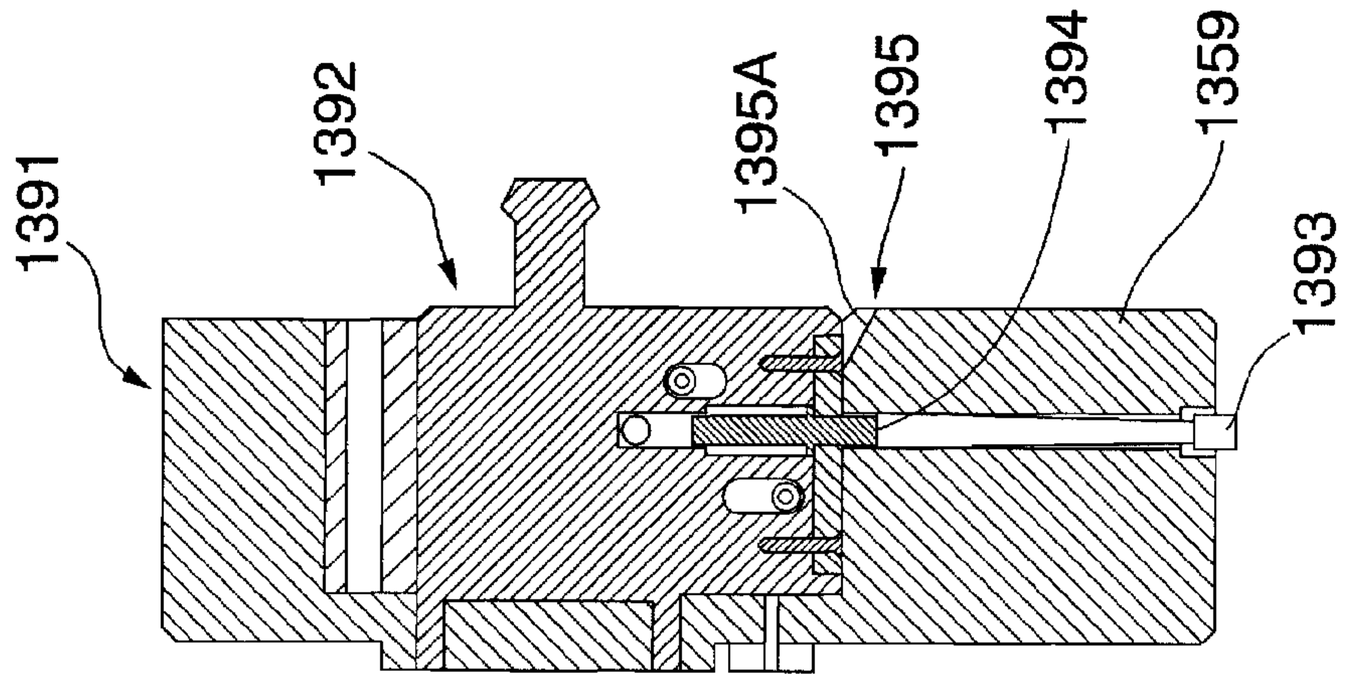

1391
1392
1395A
1395
1394
1359
1393

FIG. 56

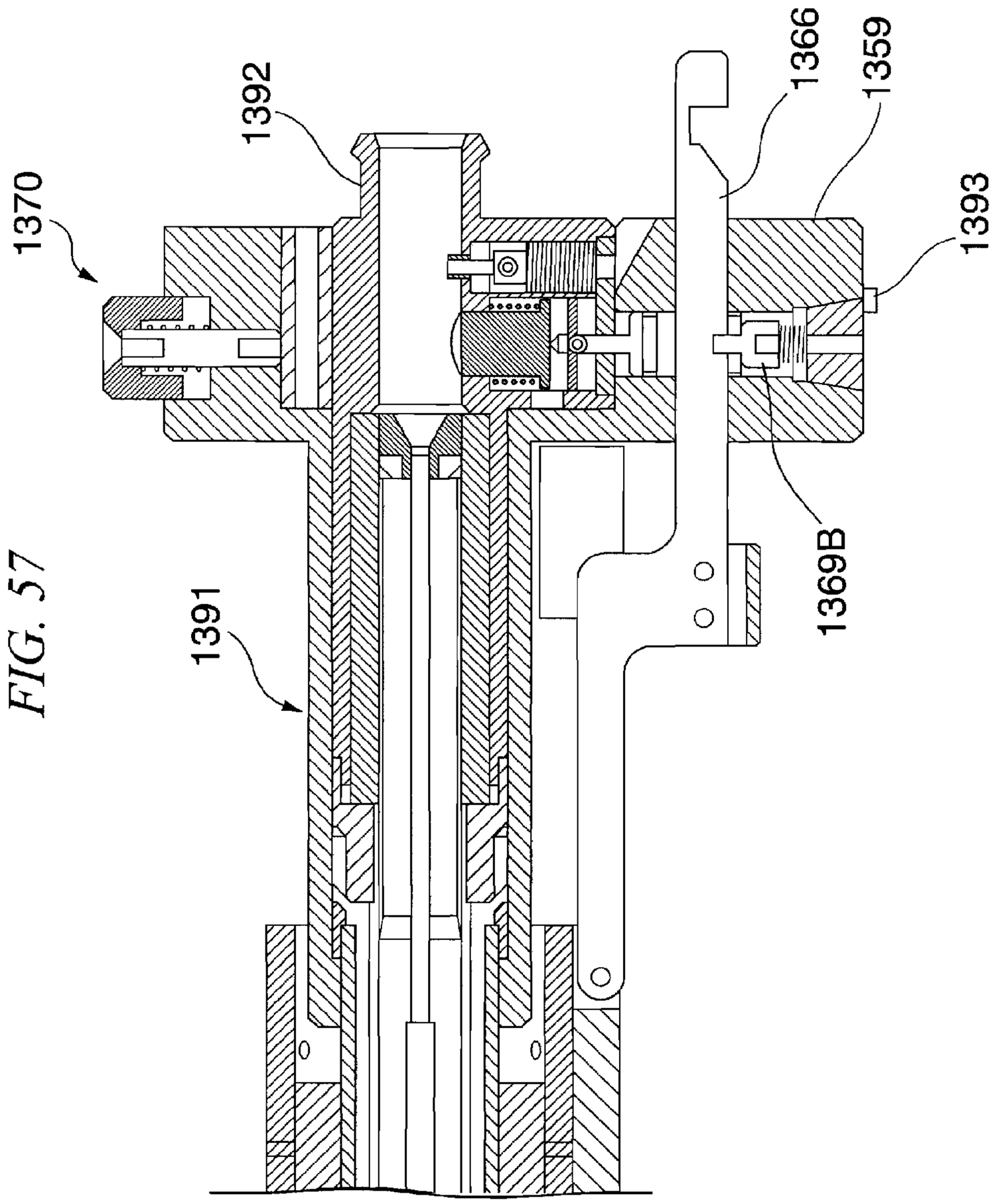

1370
1392
1366
1359
1393
1391
1369B

FIG. 57

FIG. 58

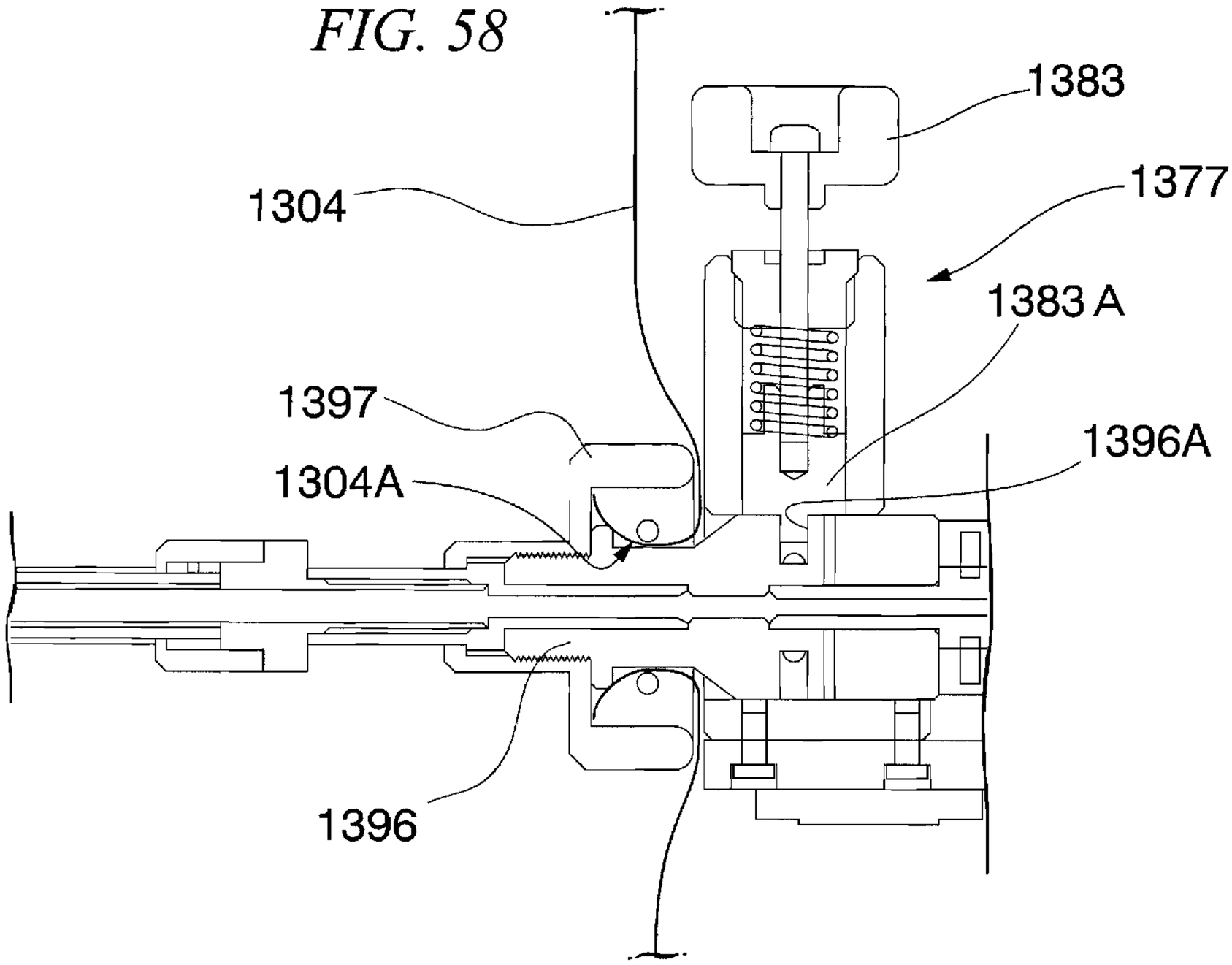


FIG. 59

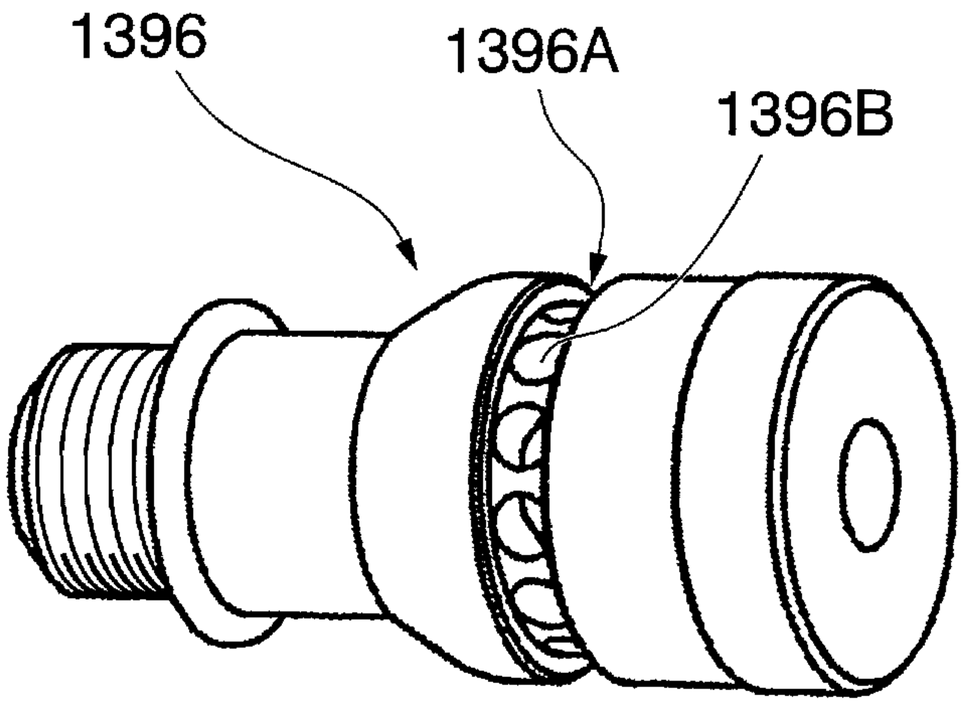


FIG. 60A

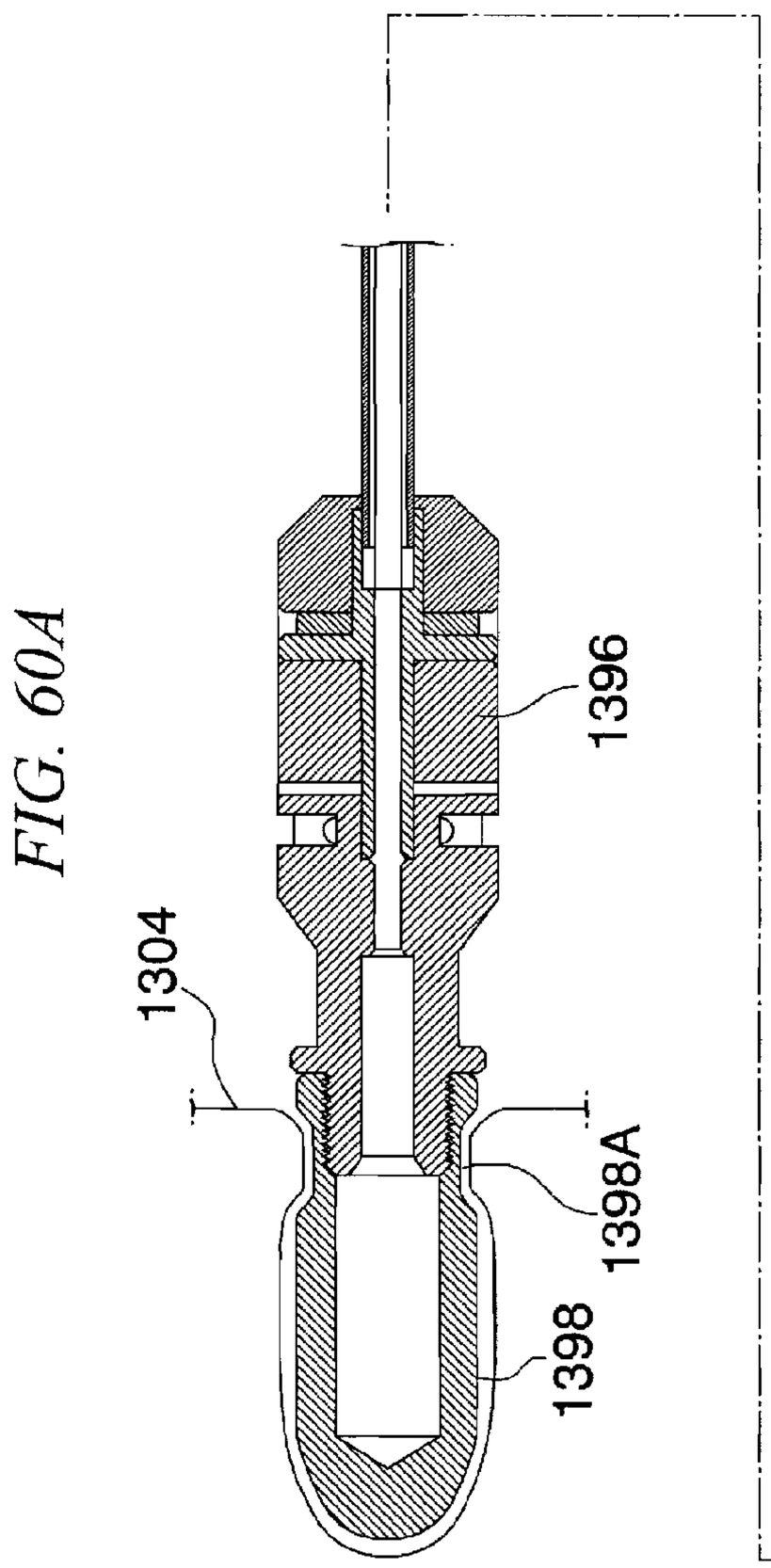
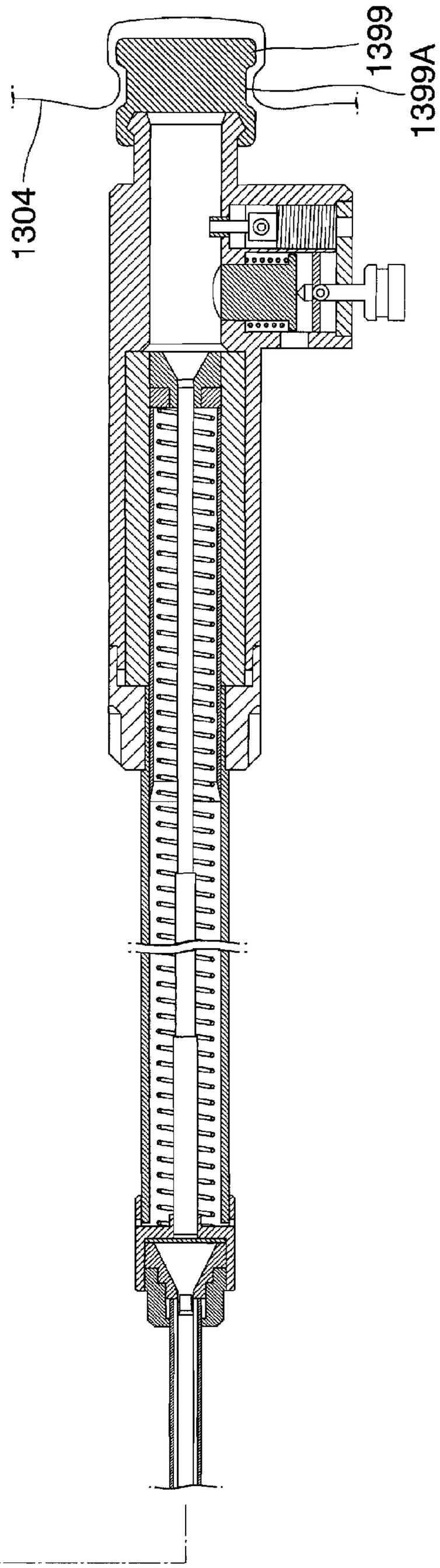


FIG. 60B



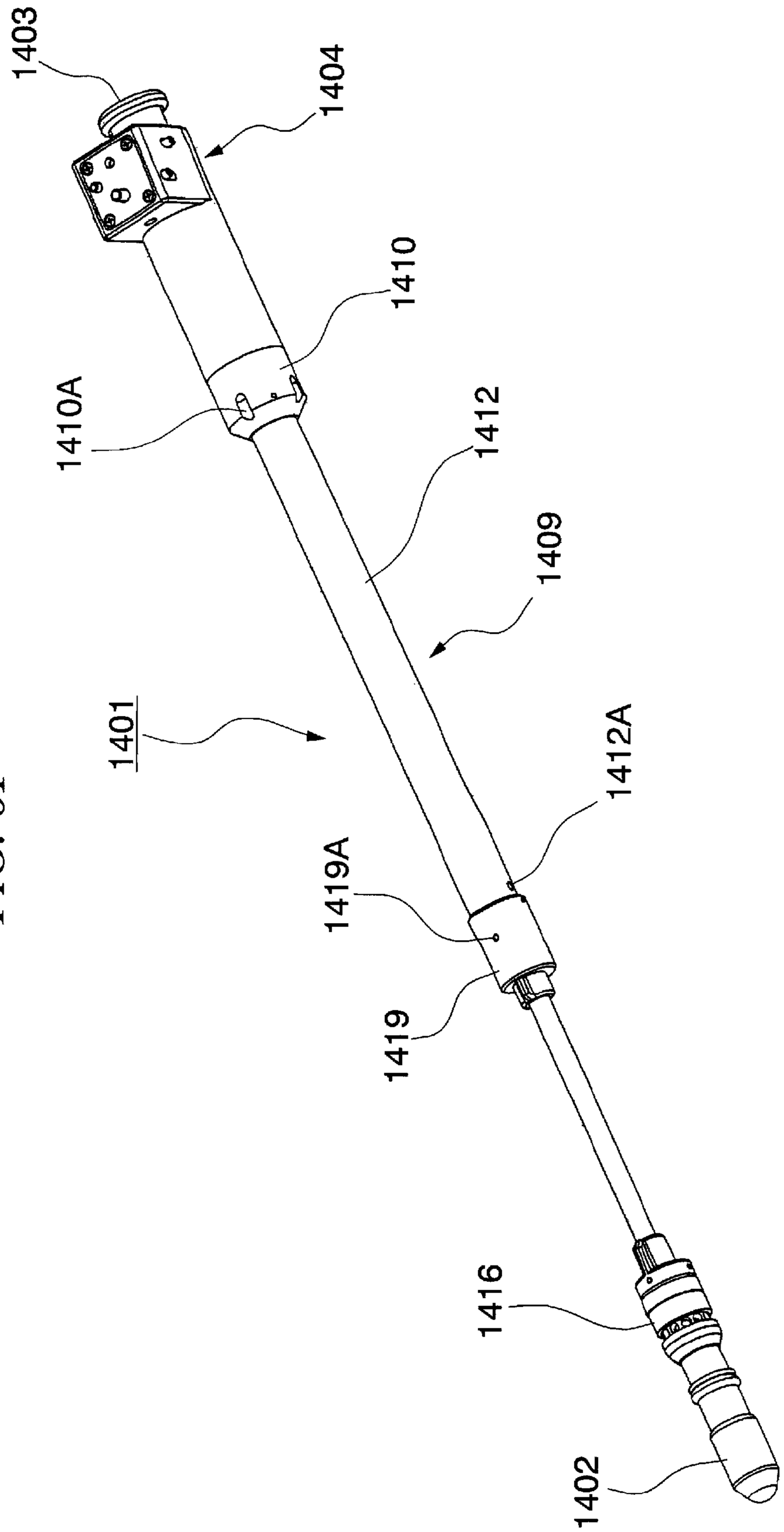
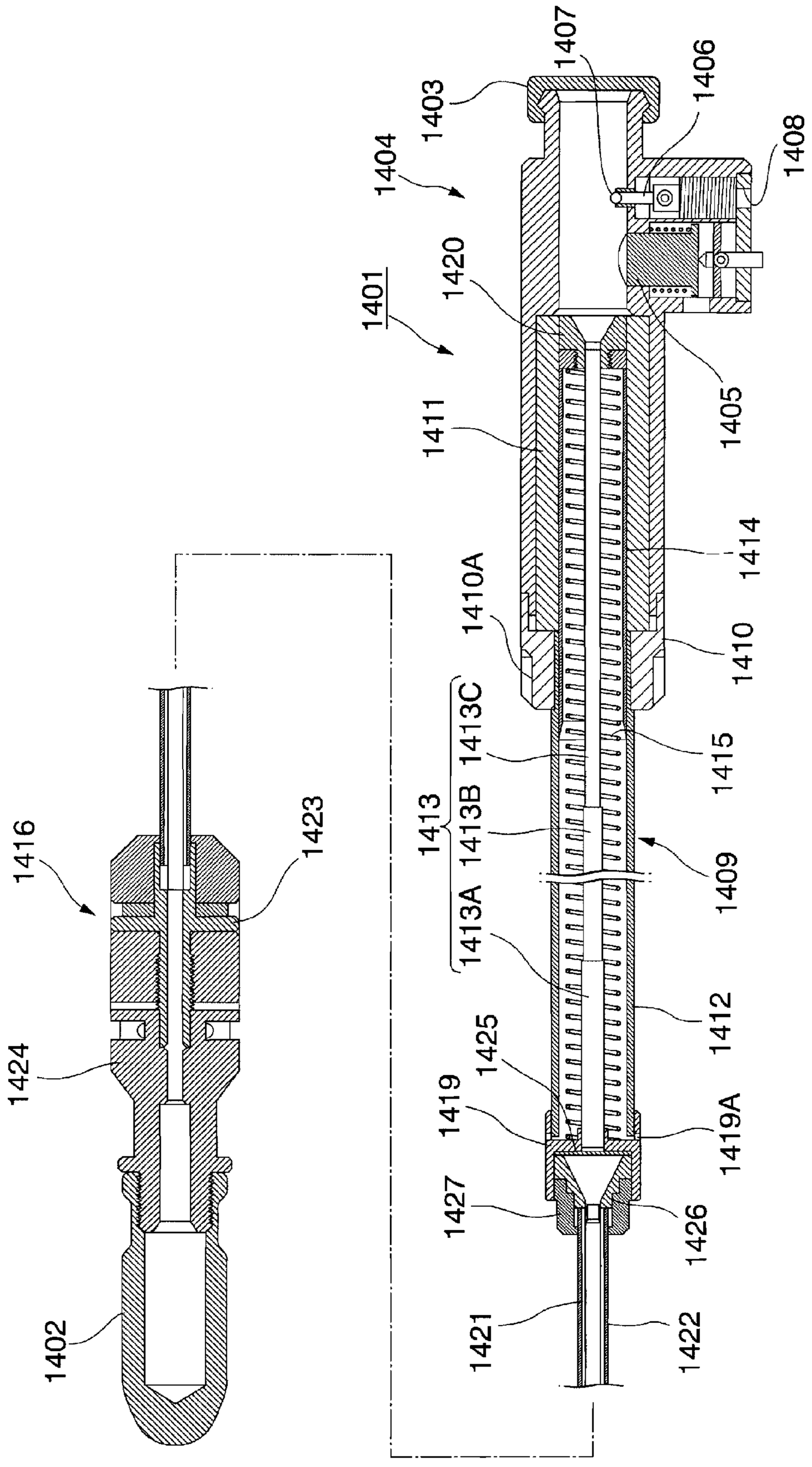

1403
1404
1410
1410A
1412
1409
1401
1412A
1419A
1419
1416
1402

FIG. 61

FIG. 62


1407
1406
1403
1408
1404
1420
1401
1405
1411
1414
1410A
1410
1413C
1415
1413
1413B
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1426
1421
1422
1416
1423
1424
1402

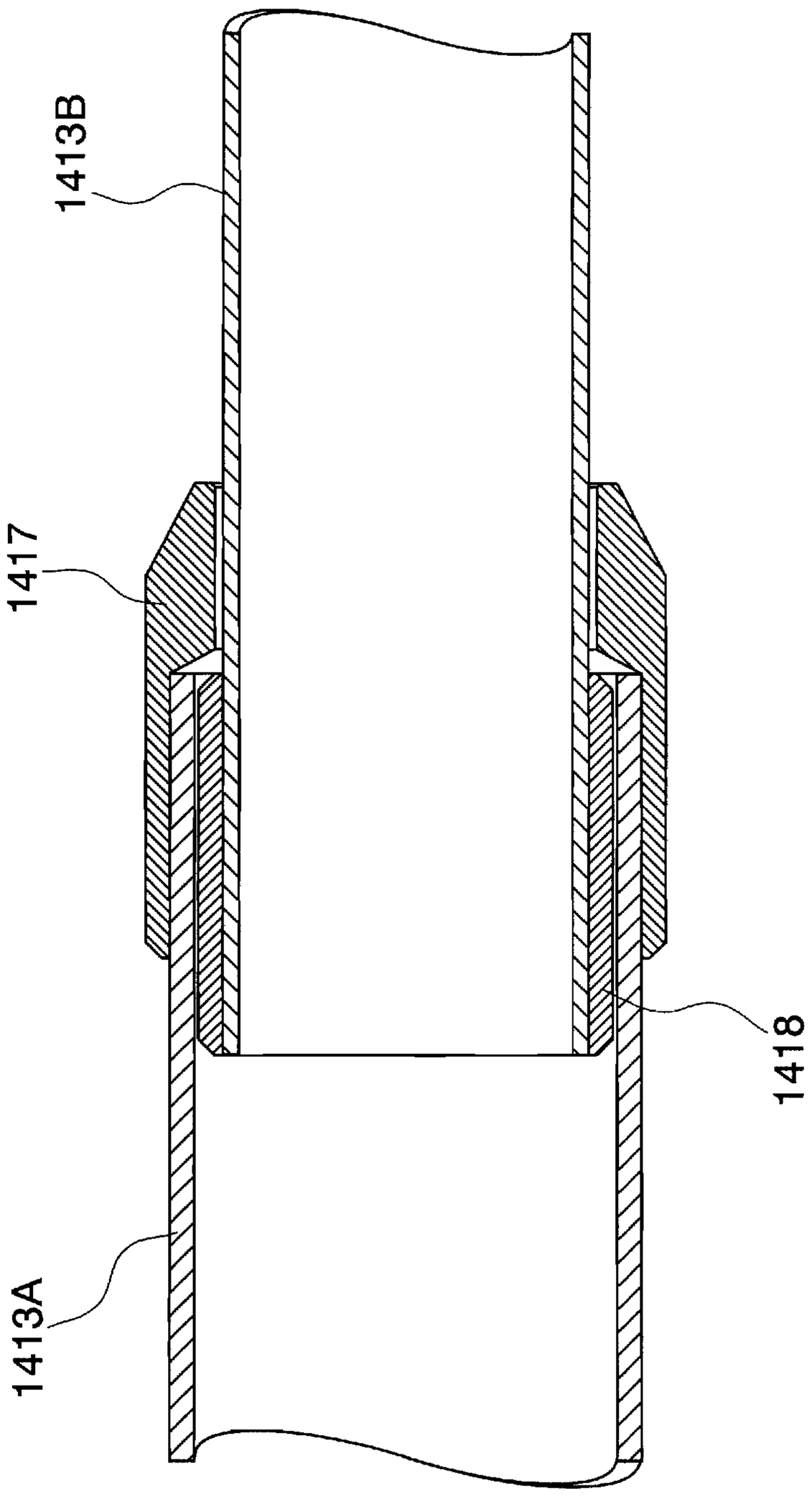


FIG. 63

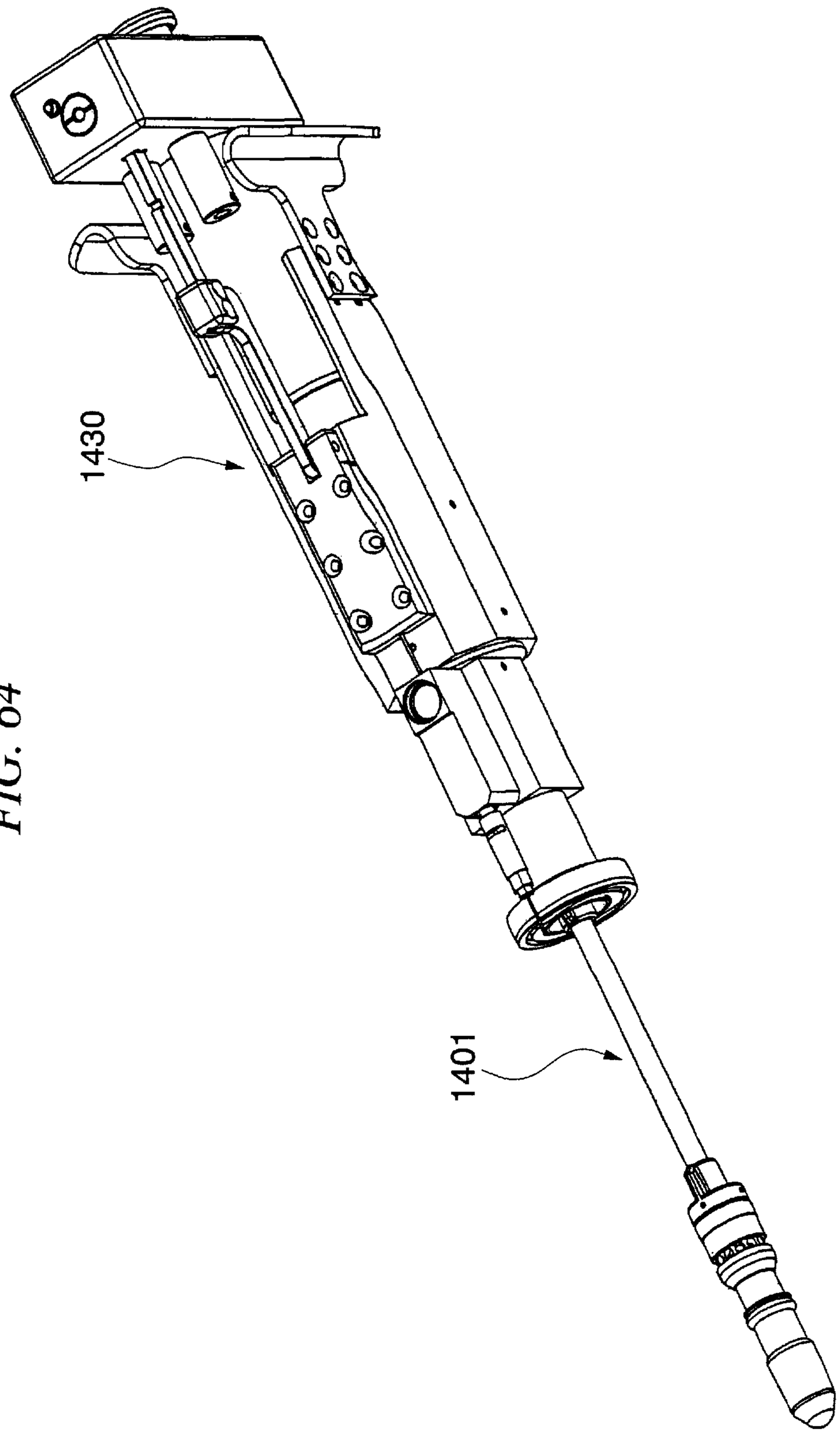


FIG. 64

FIG. 65

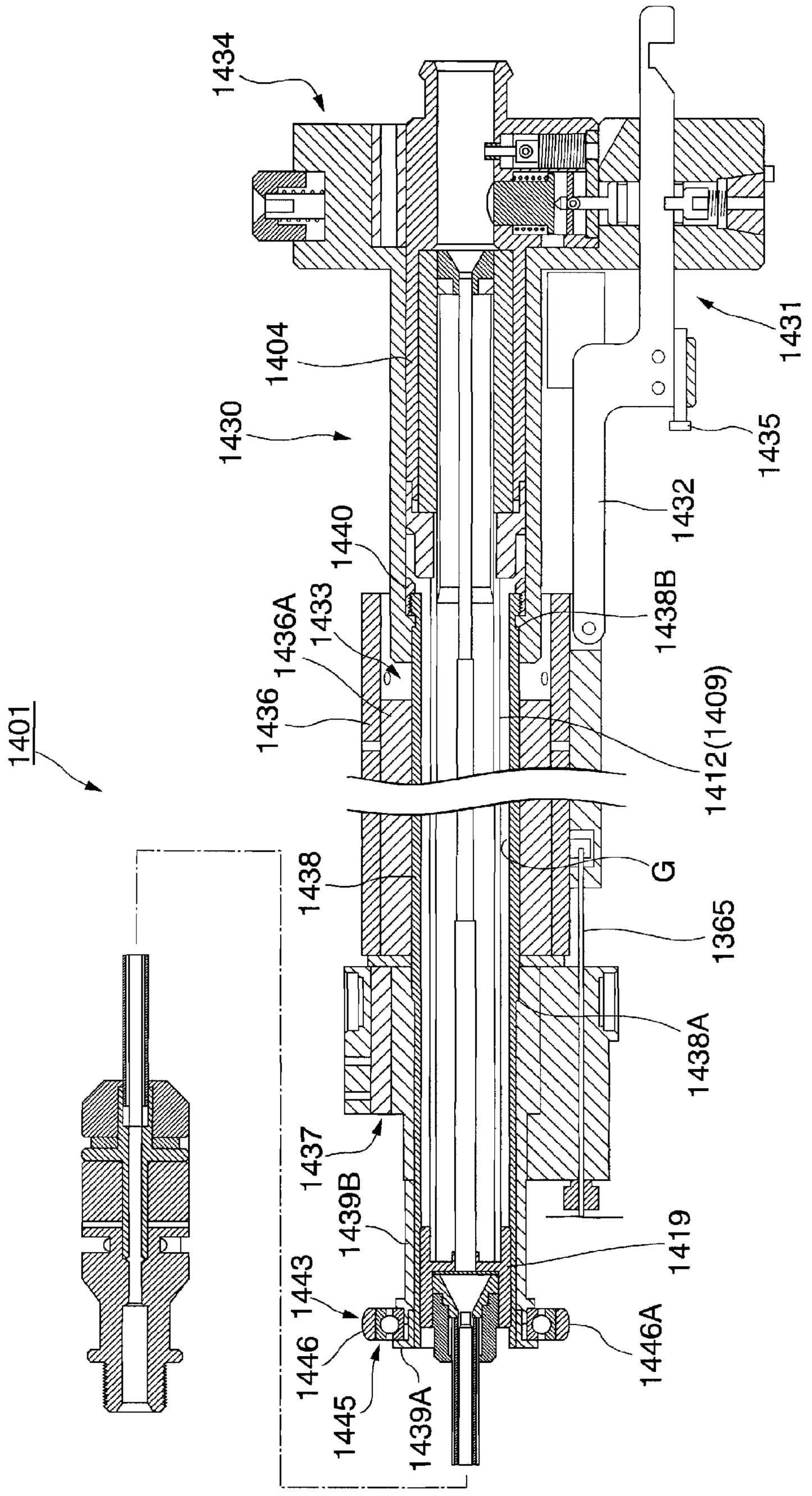
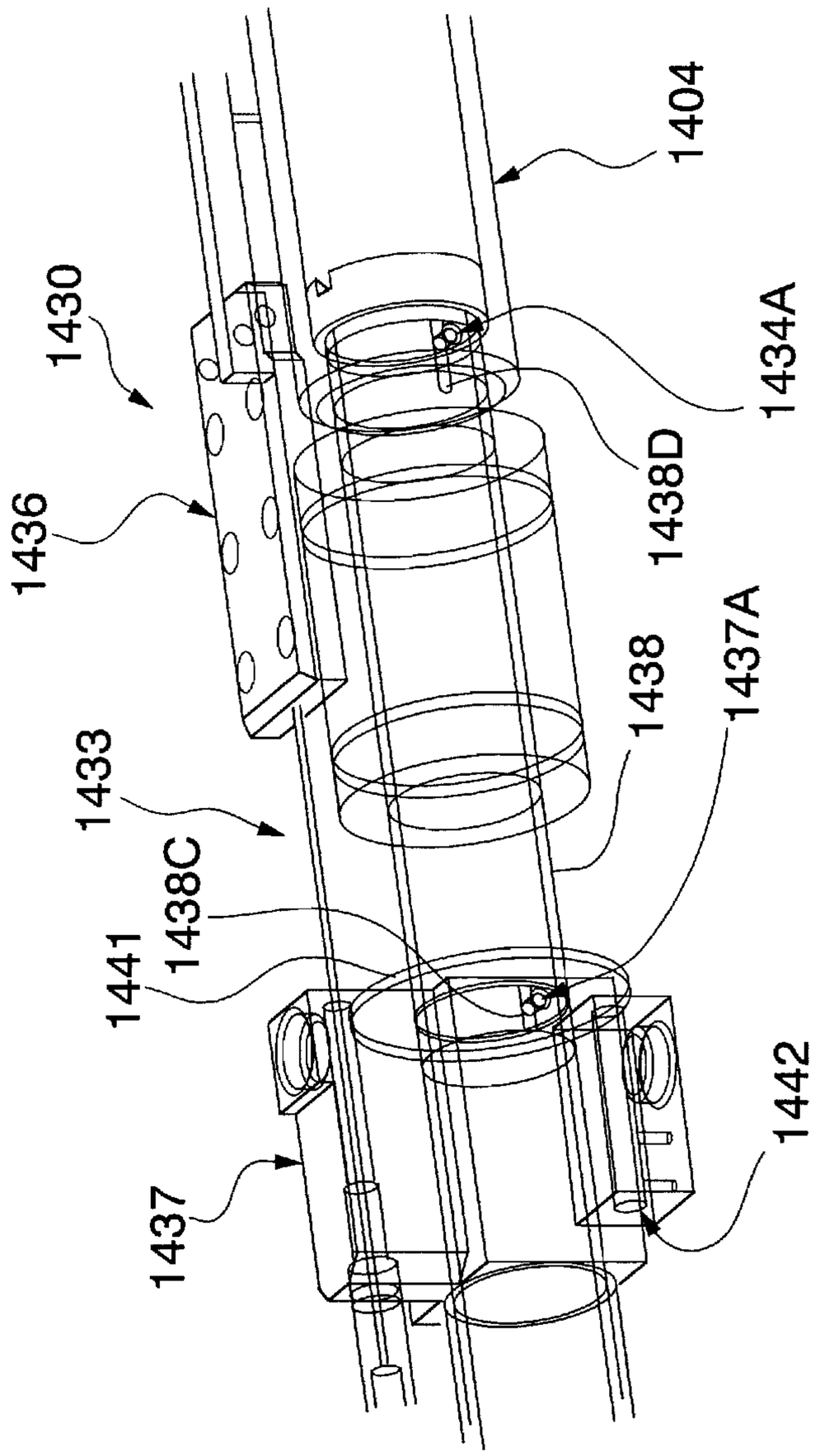

1401
1434
1404
1430
1431
1435
1432
1440
1436A
1433
1436
1438B
1412(1409)
1438
G
1365
1438A
1437
1439B
1419
1443
1446
1445
1439A
1446A

FIG. 66


1404
1430
1436
1434A
1438D
1433
1438
1437A
1438C
1441
1442
1437

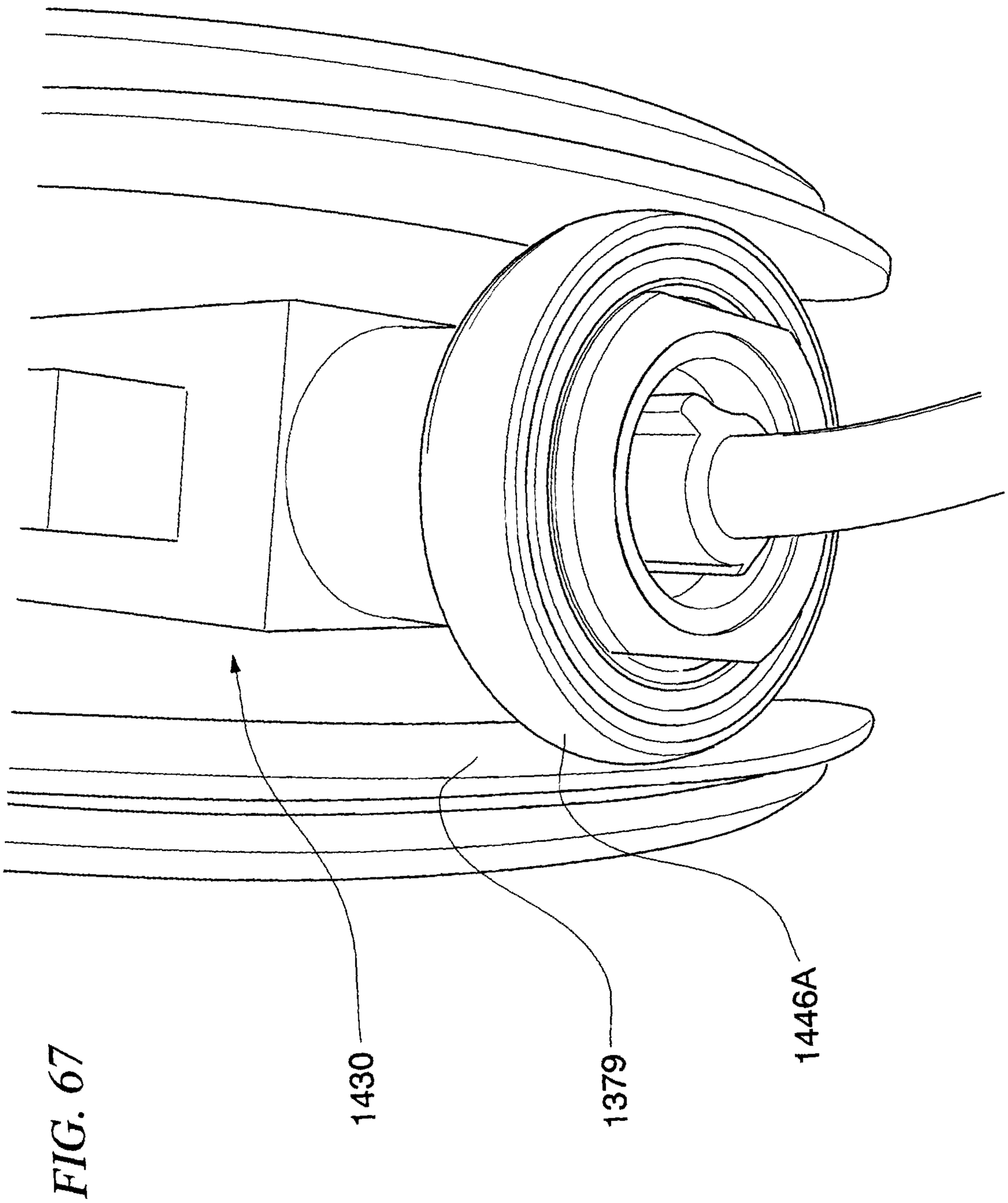


FIG. 67

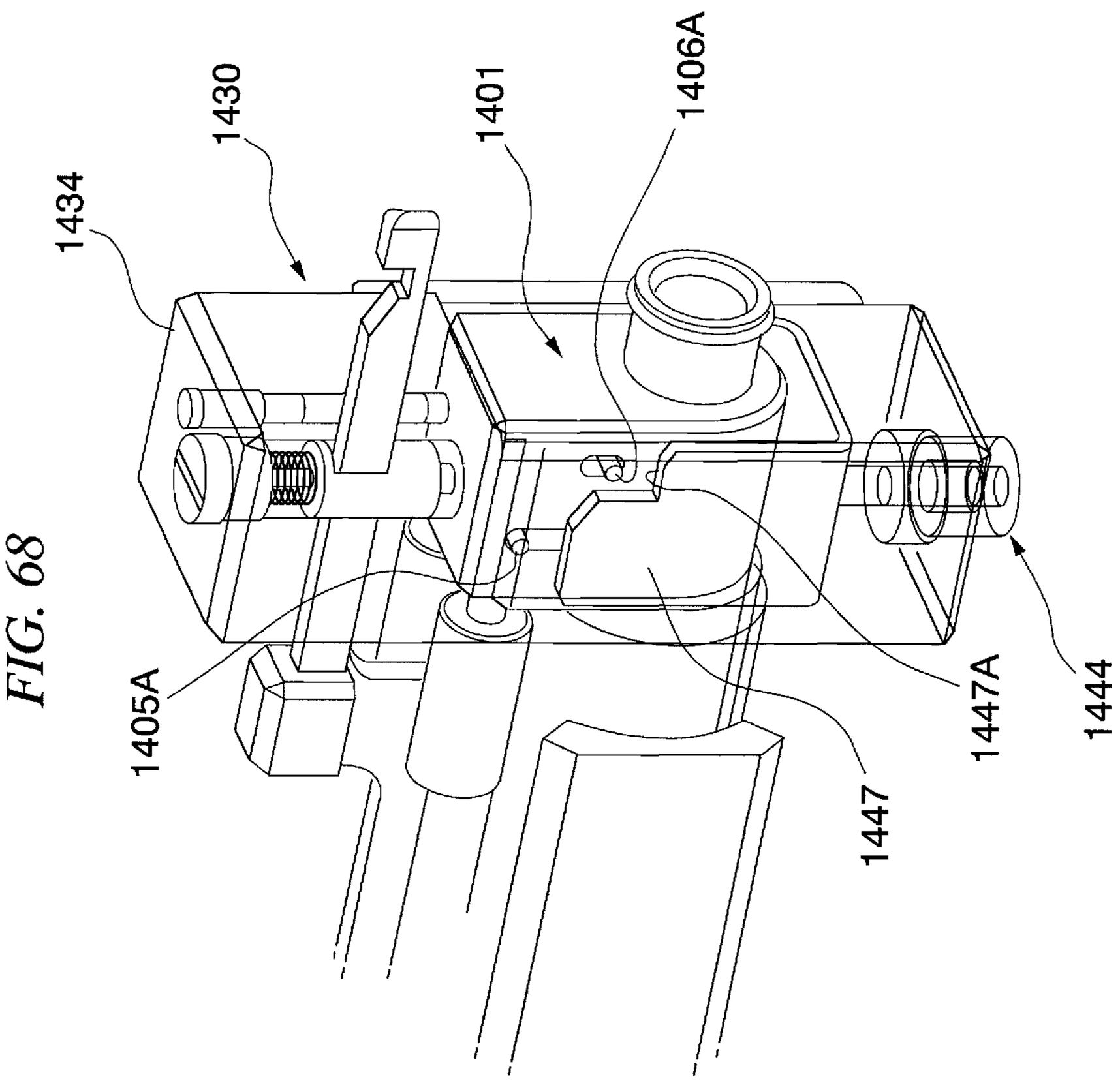


FIG. 68

MEDICAL APPARATUS

CROSS REFERENCE TO RELATED APPLICATIONS

This is a Continuation In-part Application (CIP) based on U.S. patent application Ser. No. 12/035,535, titled "MEDICAL TREATMENT ENDOSCOPE", filed Feb. 22, 2008, which is a CIP based on U.S. patent application Ser. No. 11/809,488, titled "MEDICAL TREATMENT ENDOSCOPE", filed Jun. 1, 2007, which is a CIP based on U.S. patent application Ser. No. 11/652,880, titled "MEDICAL TREATMENT ENDOSCOPE", filed Jan. 12, 2007, which is a CIP based on U.S. patent application Ser. No. 11/435,183, titled "MEDICAL TREATMENT ENDOSCOPE", filed May 16, 2006, which is a CIP based on U.S. patent application Ser. No. 11/331,963, titled "MEDICAL TREATMENT ENDOSCOPE", filed Jan. 13, 2006, the content of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a medical apparatus used to be inserted in to a body cavity.

2. Background Art

Laparoscopic surgery is a conventionally known technique that has been employed when performing a medical procedure such as observation or treatment of the internal organs of the human body. Rather than making a large abdominal incision, laparoscopic surgery allows for the procedure to be carried out by making several openings in the abdominal wall, and inserting a laparoscope and surgical instruments such as forceps into these openings. This type of surgery offers the benefit of being less invasive on the patient, since only small openings are made in the abdominal wall.

As a method of even further reducing stress on the patient, it has been proposed in recent years to carry out medical procedures by inserting a flexible endoscope into the patient via a natural opening such as the mouth, nostrils or anus. An example of a medical treatment endoscope used in such procedures is disclosed in U.S. Patent Application Publication No. 2005/0065397.

In the medical treatment endoscope disclosed in this reference, arm members that have a bendable end are respectively inserted into a plurality of lumens disposed within a flexible inserted part that is inserted into the body via the mouth of the patient. By inserting respective instruments through these arm members, the procedure site of interest can be approached from different directions with the various instruments. Accordingly, a plurality of procedures can be carried out in continuum by means of a single endoscope inserted into the body.

SUMMARY OF THE INVENTION

A medical apparatus according to the present invention includes: a flexible sheath; an arm section having a bending part capable of a bending operation and a first channel capable of inserting a procedure instrument therethrough, the arm section being disposed to protrude from a tip of the sheath; and an operation stick having a second channel connected to the first channel and a bending operating part connected to the arm section by an operation-transmission member, wherein the operation stick has: a regulation section for regulating movement of the bending operating part; and a falloff-preventive section for engaging with the procedure instrument inserted in the second channel to prevent the procedure instrument from falling from the operation stick.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a perspective view showing a medical treatment endoscope according to a first embodiment.

FIG. **2** is an enlarged view of an operation section.

FIG. **3** is a view taken along the line A-A in FIG. **2** in parallel with an axial direction of a first operation section.

FIG. **4** is a view on arrow AB in FIG. **3**.

FIG. **5** is a cross-sectional view along the line AC-AC in FIG. **4**.

FIG. **6** is a cross-sectional view along the line AD-AD in FIG. **4**.

FIG. **7** is an exploded view for a rotational axis.

FIG. **8** is a perspective view for the other rotational axis, a support chip, and a bending wire.

FIG. **9** is a cross-sectional view along the line AE-AE in FIG. **8**.

FIG. **10** is a plan view illustrating a first operation stick and a procedure instrument.

FIG. **11** is a cross-sectional view along the line AF-AF in FIG. **10** illustrating a pre-insertion state of the procedure instrument.

FIG. **12** is a perspective view for a piston.

FIG. **13** is a cross-sectional view showing an enlarged state of a first operation stick illustrated in FIG. **6**.

FIG. **14** shows a channel in magnified view.

FIG. **15** is a plan view illustrating a procedure instrument.

FIG. **16** is a cross-sectional view along the line AG-AG in FIG. **15**.

FIG. **17** describes how to attach a protection member to a ring.

FIG. **18** describes a post-attached protection member disposed to the ring.

FIGS. **19**A and **19**B illustrate a cam in a perspective view.

FIG. **20** is a view on arrow AH in FIG. **19**.

FIG. **21** is a cross-sectional view along the line AI-AI in FIG. **15**.

FIG. **22** is a cross-sectional view along the line AJ-AJ in FIG. **15**.

FIG. **23** illustrates motions provided by a cam, a piston, and a connection plate when the procedure instrument is inserted into the first operation stick.

FIG. **24** illustrates the piston pushed up by the cam.

FIG. **25** illustrates the connection plate in a retractable state.

FIG. **26** illustrates the cam disposed between two grooves of the connection plate.

FIG. **27** illustrates an engaged state of the cam to a second groove.

FIG. **28** illustrates the cam pushing up the piston when removing the procedure instrument.

FIG. **29** illustrates the piston pushed up by rotating the cam.

FIG. **30** illustrates a base having an operation section joined to a second bending slider disposed on a side of a base.

FIG. **31** is a cross-sectional view illustrating a mechanism for joining the second bending slider to the operation section in the configuration shown in FIG. **30**.

FIG. **32** shows a modified example of the cam.

FIG. **33** illustrates a feed operation for the procedure instrument.

FIG. **34** illustrates a feed operation for the procedure instrument.

FIG. **35** illustrates a combined use of the medical treatment endoscope and an overtube.

FIG. **36** shows the structure of the medical treatment endoscope according to the second embodiment of the present invention.

FIG. **37** shows an operation stick of the medical treatment endoscope.

FIG. **38** is a perspective view showing a channel unit removed from an operation stick.

FIG. **39** is a cross-sectional view of the operation stick.

FIG. **40** shows the vicinity of a channel-fixing section of the operation section of the medical treatment endoscope.

FIG. **41** is a perspective view showing the sterilized channel unit.

FIG. **42** shows the channel unit inserted into the operation section.

FIG. **43** is a cross-sectional view showing the connection section of the channel unit and the channel-fixing section.

FIG. **44** shows operation of disposing a drape onto the operation section.

FIG. **45** shows the operation section covered by the drape.

FIG. **46** shows a first cap removed from the connection section.

FIG. **47** shows the channel unit connected to the treatment instrument channel.

FIG. **48** shows the channel unit and an erroneous-movement-preventive section of the operation stick prior to insertion of the treatment instrument.

FIG. **49** shows the channel unit and the erroneous-movement-preventive section of the operation stick when the treatment instrument is inserted.

FIG. **50** shows the channel unit and the erroneous-movement-preventive section of the operation stick when a slider is drawn.

FIG. **51** shows the channel unit and the erroneous-movement-preventive section of the operation stick when the slider is fixed.

FIG. **52** shows the channel unit and the erroneous-movement-preventive section of the operation stick when the treatment instrument is further inserted.

FIG. **53** shows a removal button and channel unit of the operation stick.

FIG. **54** shows the channel unit and the erroneous-movement-preventive section of the operation stick when the removal button is pressed.

FIG. **55** is a bottom plan view showing an operation stick and a channel unit in accordance with a modified example of the medical treatment endoscope.

FIG. **56** is a cross-sectional view along the line A-A in FIG. **55**.

FIG. **57** is a cross-sectional view along the line B-B in FIG. **55**.

FIG. **58** shows the channel unit and an instrument channel in accordance with the modified example of the medical treatment endoscope.

FIG. **59** is perspective view showing a connection section of the channel unit.

FIGS. **60**A and **60**B are cross-sectional views showing the channel unit in accordance with the modified example of the present invention.

FIG. **61** is a perspective view showing the channel unit in the medical treatment endoscope according to a third embodiment of the present invention.

FIG. **62** is a cross-sectional view of the channel unit.

FIG. **63** is a cross-sectional view of the channel pipe of the channel unit in magnified view.

FIG. **64** is a perspective view showing an operation stick having a channel unit inserted therethrough.

FIG. **65** is a cross-sectional view of the operation stick having the channel unit inserted therethrough.

FIG. **66** is a perspective view showing a main body of the operation stick in magnified view.

FIG. **67** shows a tip of the operation stick attached to the operation section.

FIG. **68** shows a removal button of the operation unit.

DETAILED DESCRIPTION OF THE INVENTION

Embodiments of the present embodiment will be described as follows. The basic structure of a medical treatment endoscope as an example of a medical apparatus of the present invention is disclosed by the corresponding U.S. patent application Ser. Nos. 11/331,963, 11/435,183, and 11/652,880 of the present patent application. Disclosure by these applications is incorporated into the following explanation.

First Embodiment

A medical treatment endoscope according to the present embodiment is functionally divided into an operation section for conducting necessary treatments by means of arm sections and procedure instruments; and an endoscope operation section for operating an endoscope. The present embodiment features operation sections that are operable in separate locations from the endoscope. An operation section built in an endoscope operation section necessitates an operator conducting all the operations alone, i.e., inevitably complex operations. The present embodiment enables two operators to share operations, i.e., operating an endoscope and conducting a treatment; thus, facilitating the operations.

As illustrated in FIG. **1**, an endoscope insertion section **503** fully integrated with a medical treatment endoscope **501** extends from an end of an endoscope insertion section **502**. An elongated and flexible endoscope insertion section **503** has the same structure as those of the U.S. patent application Ser. Nos. 11/435,183 and 11/652,880. That is, the endoscope insertion section **503** has a first sheath **301** having a first arm section **302**A and a second arm section **302**B on the tip of the first sheath **301**. Treatment sections **505**A and **505**B of procedure instruments **504**A and **504**B each protrude from the tips of the arm sections **302**A and **302**B. A first bending part **306** and a second bending part **308**, in this order from the tips of the arm sections **302**A and **302**B, are formed to each arm section **302**A and **302**B. Combined use with a third bending section **203**B formed in the first sheath **301** enables a bending operation in a human body. The first and second arm members **302**A and **302**B may be inserted into another sheath protruding from the tip of the sheath **301** as disclosed by the U.S. patent application Ser. No. 11/652,880. Meanwhile, an operation section **520** is enlarged in FIG. **1** to help better understanding.

A forceps cap **510** is provided to a side of the endoscope insertion section **502** near an end that continues to the endoscope insertion section **503**. The forceps cap **510** communicates to an operation channel formed in the first sheath **301**. Inserting another procedure instrument, which is not shown in the drawing, from here enables the procedure instrument to protrude from the tip of the endoscope insertion section **503**. In addition, disposed to the endoscope insertion section **502** are a switch **511**, an angle knob **512**, and a universal cable **513** that is connected to a control apparatus that is not shown in the drawing. For example, operating the switch **511** provides air-supply, water-supply, and suction through a channel

formed in the first sheath **301**. Operating the angle knob **512** bends the third bending section **203**B into four direction with respect to an axial line.

In addition, an elongated flexible connection sheath **515** extends from the other end of the endoscope insertion section **502**. An operation section **520** is disposed at an end of a connection sheath **515**.

The operation section **520** has a base **521** that fixes the connection sheath **515**. Attached to the base **521** are a first operation unit **530**A and a second operation unit **530**B. The first operation unit **530**A has an operation stick **531**A into which an operation section **506**A of the procedure instrument **504**A is inserted. The procedure instrument **504**A is passed through the first arm member **302**A. The operation section **506**A is supported by the operation stick **531**A so as to be capable of extending and retracting in the axial line and bending in four directions with respect to the axial line. The second operation unit **530**B has an operation stick **531**B into which an operation section **506**B of the procedure instrument **504**B is inserted. The procedure instrument **504**B is passed through the second arm member **302**B. The operation section **506**B is supported by the operation stick **531**B so as to be capable of extending and retracting in the axial line and bending in four directions with respect to the axial line. Furthermore, the operation section **520** fixed to an operation bed enables operation of the first second operation unit **530**A and the second operation unit **530**B.

As illustrated in FIG. **2** in an enlarged view, the operation units **530**A and **530**B are disposed diagonally so that portions closer to the connection sheath **515** are placed closer to each other. Two operation sections **506**A and **506**B (or two operation sticks **531**A and **531**B) are disposed at angles between 20° and 100°. Disposing the operation sections **506**A and **506**B with the opening angle relative to an operator facilitates the operator's operation, thus improving operability. In addition, the width of the operation section **520** closer to the connection sheath **515** can be reduced. Also, as disclosed by U.S. patent application Ser. No. 11/652,880, disposition (in horizontal direction) of arm sections **302**A and **302**B in an endoscope image obtained through an object lens of a viewing device (viewing unit) attached to the first sheath **301** can be coincided with the disposition (in horizontal direction) of the two operation units **530**A and **530**B. This improves correlation of an operator's perception and actual inner-body movement, thereby facilitating manipulation. Furthermore, less force is required for an operator to operate only the operation sticks **531**A and **531**B and the operation sections **506**A and **506**B of the procedure instruments **504**A and **504**B. Dispositions having reverse correlation with respect to horizontal or vertical direction provide similar operational perception obtained by laparoscopic instruments.

The configuration of the first operation unit **530**A is explained.

As illustrated in FIGS. **2** to **4**, the first operation unit **530**A has a bracket **551**A fixed to the base **521**. The bracket **551**A is fixed so that an opening **552**A is substantially orthogonal to the center line of the first operation unit **530**A. A first rotation mechanism **561**A is attached to horizontal side surfaces of the bracket **551**A. The first rotation mechanism **561**A has a pair of support chips **562**A and **563**A that are fixed to place the opening **552**A of the bracket **551**A therebetween. A rotation shaft **564**A is disposed to the support chip **562**A. A rotation shaft **565**A is disposed to the support chip **563**A. The rotation shafts **564**A and **565***a* are disposed coaxially. A frame **567**A is supported by this pair of rotation shafts **564**A and **565***a* so as to be freely capable of rotating with respect to the bracket **551**. An opening of a rectangular frame **567**A is disposed orthogonal to the center line of the first operation unit **530**A. The operation stick **531**A is inserted through the frame **567**A. The operation stick **531**A engaging with the frame **567**A in rotating angles of the rotation shafts **564**A and **565***a* is inserted so as to be independently capable of tilting in the axial lines of the rotation shafts **564**A and **565**A.

As illustrated in FIG. **5**, the tip section **571**A of the operation stick **531**A extends beyond the frame **567**A. Ball rollers **572**A are provided to the tip section **571**A. The ball rollers **572**A are disposed to place the center line of the operation stick **531**A therebetween. The line passing through the centers of two ball rollers **572**A is parallel with the axial lines of the rotation shafts **564**A and **565**A of the first rotation mechanism **561**A as illustrated, i.e., where the operation stick **531**A is not tilted. Distances Laa between the rotation shaft **564**A and **565**A and the ball rollers **572**A are, for example, 50 to 200 mm.

Frames **580**A of the second rotation mechanism **581**A are farther disposed so as to place the ball rollers **572**A therebetween and slide on the ball rollers **572**A. The frames **580**A are supported rotatively by the pair of rotation shafts **584**A and **585**A. The pair of the rotation shafts **584**A and **585**A are disposed coaxially so that the axial lines are orthogonal to a pair of rotation shafts **564**A and **565**A and also orthogonal to the center line of the first operation unit **530**A. The rotation shafts **584**A and **585**A are supported by support chips **582**A and **583**A each fixed on a vertical side surface of the bracket **551**A.

The configuration of the rotation shafts **584**A and **585**A of the second rotation mechanism **581**A will be explained here. Since the rotation shafts **584**A and **585**A have the same configuration, the rotation shaft **584**A will be explained herein for reference.

As illustrated in FIGS. **6** and **7**, the rotation shaft **584**A has a bearing **591** fixed to the support chip **582**A. The bearing **591** has a flange at an end of the cylinder so that the bearing **591** is fixed to the support chip **582**A by bolts passing through holes formed on the flange. Outer rings of the bearings **592** and **593** are press-fitted into the inside of the cylinder of the bearing **591** so as to be separate in the axial line. A drive shaft **594** is supported by the bearings **592** and **593** rotatively relative to the bearing **591**. The reduced diameter portion of the drive shaft **594** passes through the bearing **591**.

An end section of the drive shaft **594** is enlarged in diameter substantially to that of the bearing **591**. A coil spring **596** is wound around between an outer periphery of the drive shaft **594** and an outer periphery of a cylindrical section of the bearing **591**. Terminals **596**C and **596**D are bent on both sides of the coil spring **596**. A terminal **596**C is engaged with a groove formed on the flange **594**C formed at an end of the drive shaft **594**. An elemental wire of the coil spring **596** is rectangular in cross section. The rectangular shape may be a square or a rectangle.

The drive shaft **594** is formed by a protrusion **594**D and a flange **594**C. A plurality of screw holes are formed around the protrusion **594**D. Each rotative pin **597** is screwed into each screw hole disposed by 180 degrees offset in a circumferential direction. An inner ring of the bearing **598** is press-fitted and fixed into the protrusion **594**D. A bearing **599** is attached to an outer periphery of the bearing **598**. The bearing **599** has a cylindrical section **599**D having a flange. Inserted in advance into the cylindrical section **599**D is a ring retainer **600** that depresses the ring retainer **600** toward a drive shaft **594** with a preload screw **602** via a diaphragm spring **601**. A plurality of through-holes **599**C are formed on the flange of the bearing **599** at equal intervals in a circumferential direction. The through-holes **599**C are disposed corresponding to the dispo-

sition of the screw holes of the drive shaft **594**. The diameter of the through-hole **599**C is greater than that of a head portion of the rotative pin **597**. That is, the through-hole **599**C has freeplay.

Provided further to cover the flange **594**C of the bearing **594** and a coil spring **576** is a cylindrical cover **603**. A notch **603**C is formed on a base portion of the cover **603**. The other terminal **596**D of the coil spring **596** is hooked at the notch **603**C. In addition, a cylindrical section **599**D of the bearing **599** protruding from the cover **603** is fixed to the frames **580**A by a pin.

Since an initial state of the coil spring **596** tightens the outer peripheries of the drive shaft **594** and the bearing **591**, the drive shaft **594** is joined to the bearing **591** by the coil spring **596**. Since the bearing **591** is fixed to the support chip **582**A, the drive shaft **594** cannot rotate in the direction for tightening the coil spring **596**. However, it is rotatable in a direction for loosening the coil spring **596**. In contrast, a tilting movement provided by an operator of the operation stick **531**A into the direction for tightening the coil spring **596** tilts the frames **580**A that makes contact with the operation stick **531**A. Tilting the frames **580**A rotates the bearing **594** of the rotation shaft **584**A and the cover **603**. Rotating the cover **603** loosens the coil spring **596**, thereby releasing the drive shaft **594** locked to the bearing **591**. This results in allowing the drive shaft **594** to rotate, thereby transferring the rotation to a sprocket **595**. The present symmetric disposition of the rotation shaft **585**A with respect to the operation stick **531**A transfers the rotational movement of the operation stick **531**A but not the rotational movement for tightening the coil spring **596** from the sprocket **595**. The operator's operation is transferred but a reaction force by the sprocket **595** is maintained when the operator stops the operation. Thus, the position is maintained, and the operation can be facilitated.

The coil spring **596** for use in such a spring clutch must be made from a high-hardness material. Use of a high-gravity material, e.g. iron, may cause an increase in the weight of the operation section **520**. Therefore, a high-hardness and low-gravity material, e.g., duralumin (#2000) or extra super duralumin (#7000), may be used.

Meanwhile, loosening the coil spring **596** to release the locked state and transferring the rotation via the coil spring **596** inevitably provide an excessive force acting on the coil spring **596**. In order to avoid such a state, a play is provided so that the head portion of the rotative pin **597** of the drive shaft **594** makes contact with a periphery wall of the through-hole **599**C of the bearing **594** after releasing the locked state. Rupture of the coil spring **596** is prevented by transferring the rotation by means of the rotative pin **597**. The spring clutch having such a configuration is not limited to the present embodiment and can be used for a rotative structure for the procedure instrument or for the overtube.

In addition, a drive shaft **584** protruding from the flange of the bearing **591** is supported by bearings **613** and **614** so as to be rotative with respect to a hollow shaft **612**. The sprocket **595** is fixed to a hollow shaft **611**. It should be noted that a rotative member for pushing and drawing a wire, e.g., a wire pulley, may be used in place of the sprocket **595**.

The hollow shaft **612** is rotatively supported by the bearing **592** with respect to the bearing **591**. The drive shaft **594** and the hollow shaft **612** both protruding over the sprocket **595** are inserted in a torque limiter **611**. The torque limiter **611** includes an outer **611**C fixed to the hollow shaft **612** and an inner **611**D fixed to the drive shaft **594**. The inner **611**D and the outer **611**C unitarily rotate until a predetermined torque is applied. When excessive torque is applied, the outer **611**C slides on the inner **611**D; and thus, the rotation is not transferred.

As illustrated in FIG. **8** showing a configuration of the rotation shaft **585**A, the sprocket **595** is rotatively housed in a circular recessing section **621** formed in the support chip **583**A. A chain **622** is wound on teeth of the sprocket **595**. A groove **623** is formed to the support chip **583**A. An end part of the chain **622** can be drawn into a groove **623** that continues to the recessing section **621**. The groove **623** is formed deeper than the recessing section **621**. Providing a gap **624** between the groove **623** and the recessing section **621** prevents the chain **622** from being entangled between the sprocket **595** and the recessing section **621**, thus guiding the chain **622** into the groove **623**.

A first bending wire **315**A is fixed to an end part of the chain **622**. The first bending wire **315**A bends the first bending parts **306** of the first arm members **302**A illustrated in FIG. **1** in a right-hand direction.

As illustrated in FIG. **8**, the first bending wire **315**A is drawn into an adjuster **641** disposed at an end part of the groove **623** of the support chip **583**A and introduced into a connection sheath **515** together with the coil sheath passing through a coil sheath **642** connected to the adjuster **641**. The first bending wire **315**A is finally reached to the first arm member **302**A. As illustrated in FIGS. **8** and **9**, the adjuster **641** has a coil base **651** fixed to the support chip **583**A. A screw hole **651**A is formed to the coil base **651**. An adjustment shaft **652** having a thread on the outer periphery thereof is screwed into the screw hole **651**A. The adjustment shaft **652** is a cylinder having a bottom. An end section **652**A corresponds to the bottom part into which a coil stopper **653** is inserted. The removal of the coil stopper **653** is prevented by engaging a flange-shaped protrusion **653**A with an inner surface of the end section **652**A. Removal prevention in the reverse direction is provided by attaching a lock-screw **654** to the outer periphery. An end part of the coil sheath is fixed to the coil stopper **653**. The first bending wire **315**A passes through the adjustment shaft **652**, followed by the coil stopper **653** and the coil sheath **642**. The first bending wire **315**A sometimes loosely extends during the step using the medical treatment endoscope **501**. In this case, inserting a fixture into a hole **652**B of the adjustment shaft **652** and rotating them cause the coil sheath **642** together with the adjustment shaft **652** to move in the axial direction. Forwarding the coil sheath **642** draws the first bending wire **315**A from the coil sheath **642**, thereby adjusting the loose state. Since the loose state can be adjusted by means of a screw, it is not necessary to dissemble the apparatus. Since the adjustment shaft **652** is rotatively engaged with the coil stopper **653**, rotating the adjustment shaft **652** will never rotate the coil sheath **642**.

Also, a sprocket **595** of the rotation shaft **584**A is housed in the support chip **582**A, and the chain **622** is wound around the sprocket **595**. A first-bending wire which is not shown in the drawing is attached to the chain **622**. The first bending wire **315**A bends the first bending parts **306** of the first arm members **302**A illustrated in FIG. **1** in a right-hand direction. An adjuster **641**, also provided to the support chip **582**A, can adjust the loose state by forwarding or drawing the coil sheath **642** having the first bending wire **315**B therethrough. The first bending wire **315**B inserted through the coil sheath **642** is introduced into the connection sheath **515** together with the coil sheath **642** and reached to the first arm member **302**A.

As explained previously, the torque limiters **611** provided to the rotation shafts **584**A and **585**A prevent the rotation of the rotation shaft **585**A from being transferred to the sprocket **595** when an excessive input is provided from the operation

stick **531**A. This results in preventing an excessive force from being applied to the first bending wire **315**A. Considering a case assumed to use no torque limiter **611** may lead to a possibility where an excessive force is applied to the first bending wire **315**A. The torque limiter **611** for controlling the maximum torque can prevent the first bending wire **315**A from being fractured. In addition, disposing the torque limiter **611**, the sprocket **595**, and the rotation shafts **564**A and **565**A in this order from the outside shorten the distance between the support chips **582***a* and **583**A, thereby downsizing the bracket **551**A. This increases freedom in layout and contributes to a downsized and light-weight configuration.

The first rotation mechanism **561**A will be explained next principally with reference to FIG. **5**.

A rotation shaft **564**A has a similar configuration to the rotation shaft **584**A of the second rotation mechanism **581**A except for the drive shaft **594** attachably engaged with the frame **567**A via the rotative pin **597** in the rotative direction. Similarly, the other rotation shaft **565**A has a similar configuration to the rotation shaft **585**A of the second rotation mechanism **581**A except for the drive shaft **594** attachably engaged with the frame **567**A via the rotative pin **597** in the rotative direction.

Furthermore, a first bending wire **315**D is joined to the sprocket **595** of one of the rotation shafts **564**A via the chain **622**. A first bending downward-operating wire **315**D is joined to the sprocket **595** of one of the rotation shafts **564**A via the chain **622**. The first bending wire **315**C and the bending wire **315**D bend two first bending parts **306** of the first arm members **302**A illustrated in FIG. **72** in vertical opening directions. The adjuster **641**, also provided to the support chip **562**A and **563**A, can adjust the loose state by forwarding or drawing the coil sheath **642** having the first bending wires **315**C and **315**D therethrough.

Next, the operation stick **531**A will be described.

In the operation stick **531**A as illustrated in FIGS. **5**, **6**, and **10**, three cylindrical shafts **701**, **702**, and **703** bundled together are fixed to a tip portion to which a ball roller **572**A is attached. The central shaft **701** is longer than two shafts, i.e., shafts **702** and **703**. The other two shafts **702** and **703** barely reach to an abutment section **710** that serves as a rotative fulcrum making contact with the frame **567**A of the first rotation mechanism **561**A. In contrast, the central shaft **701** extends beyond an abutment section **710**.

A second bending slider **711** capable of freely forwarding or retracting in the axial direction is attached to the central shaft **701**. Furthermore, a ratchet base **712** is fixed to a base end of the shaft **701**. In the initial state, the second bending slider **711** cannot be extended or retracted because the second bending slider **711** is joined to the ratchet base **712** by a connection plate **713** connected to the second bending slider **711**.

As illustrated in FIG. **11**, a through-hole **712**A is formed in the center of the ratchet base **712**. The through-hole **712**A serves as an entrance from which the operation section **506**A of the procedure instrument **504**A is inserted. Furthermore, a part **712**B of an outer periphery of the ratchet base **712** extends in a direction orthogonal to the axial line direction. Putting a thumb here allows the second bending slider **711** to be smoothly forwarded or retracted. A piston **715** slidable in a radial direction is housed in the ratchet base **712**. The piston **715** is urged by a coil spring **716** in a radial direction orthogonal to the axial line direction. A protrusion **715**A at the tip protrudes into a through-hole **712**A that is an insertion path for the procedure instrument **504**A. A slit **717** is formed on the piston **715**. An engagement chip **717**A is formed in the slit **717**. A first groove **718** of the connection plate **713** is engaged with the engagement chip **717**A. The first groove **718** is inserted through a slit **712**C penetrating the ratchet base **712**. Meanwhile, a vertical groove **717**C that is parallel in a radial direction may be formed on the piston **715** as illustrated in FIG. **12**. Inserting the tip portion of a clamping-bolt **716**A (see FIG. **10**) into a vertical groove **717**C of an outer periphery of the ratchet base **712** can prevent the rotation of the piston **715**. This prevents the piston **715** from galling the connection plate **713**, thereby providing smooth movements of the piston **715** and the connection plate **713** as explained later.

The tip of the connection plate **713** is joined to the second bending slider **711** by a fulcrum pin **721** and extends substantially parallel in the axial line from here toward the ratchet base **712**. The recessing shape of the first groove **718** allows the engagement chip **717**A of the piston **715** to enter there, and a midpoint of the wall surface of the tip portion of the first groove **718** forms an inclination surface **718**A. The inclination surface **718**A gradually widens the first groove **718** from the midpoint to the tip portion. A second groove **719** is formed at a further tip portion than the first groove **718** is formed. The recessing shape of the second groove **719** allows the engagement chip **717**A of the piston **715** to enter there. The second groove **719** is deeper than the first groove **718**. The base end wall surface of the second groove **719** forms an inclination surface **719**A. The inclination surface **719**A gradually widens the second groove **719** toward the tip portion. The first groove **718** is positioned so that the second bending part **308** of the first arm member **302**A as illustrated in FIG. **1** becomes straightened. The second groove **719** is positioned so that the second bending parts **308** bend to open the first arm member **302**A. This allows the arm section **302**A to close by engaging the first groove **718** with the piston **715**, and allows a second arm member **303**A to open by engaging the second groove **719** with the piston **715**. As previously described, the engagement of the piston **715** with the grooves **718** and **719** can be released with a small force since the inclination surfaces **718**A and **719**A are formed in the grooves **718** and **719**. This facilitates smooth switching of the engagement position of the piston **715** with the grooves **718** and **719**. As illustrated in FIG. **23**, a spring **791** forces the second bending slider **711** and the connection plate **713** to be positioned toward the tip portion by the spring force when the procedure instrument **504**A is not inserted and thus, the first groove **718** engages with the piston **715**. As illustrated in FIG. **25**, the piston **715** is pushed by the operation section **506**A of the procedure instrument **504**A when the procedure instrument **504**A is inserted. Since this state of the engagement chip **717**A can move up the inclination surface **718**A, the second bending slider **711** can be drawn, and the second bending part **308** can be opened. In this configuration, the procedure instrument **504**A must be inserted to draw the second bending slider **711** because the tip of the procedure instrument **504**A can hardly be passed through the opening state of the second bending part **308**. As illustrated in FIG. **27**, the engagement chip **717**A makes contact with the inclination surface **719**A as long as the second bending slider **711** is drawn toward the base end. The tension applied by second bending wires **316**A and **316**B urges the slider **711** toward the tip. As illustrated in FIGS. **28** and **29**, raising the piston **715** necessitates a significant force if the disposition angle of the inclination surface **719**A is significantly equal to 90°. If the disposition angle is substantially horizontal, the piston **715** is spontaneously raised by the tension applied by the second bending wires **316**A and **316**B and therefore, the second bending slider **711** moves toward the tip, and the second bending part **308** closes. The suitable angle α of the inclination surface **719** is $60° \leq \alpha < 90°$.

The second bending slider **711** is disposed coaxially with the axial line of the operation stick **531**A. Therefore, the compact first operation unit **530**A can be obtained. Formed at the base end thereof is an edge section **711**A for putting a thumb. A linear stroke **722** is built in a portion making contact with the shaft **701** to provide smooth sliding movement on the shaft **701**.

As illustrated in FIG. **13**, two pipes **731** are attached to the tip of the second bending slider **711** so as to place the axial line between pipes **731**. Second bending wires **316**A and **316**B are passed respectively through these pipes **731**. The second bending wires **316**A and **316**B are fixed to an engagement member **732** in the second bending slider **711** so that the second bending wires **316**A and **316**B cannot be removed from the second bending slider **711**. Disposing the second bending wires **316**A and **316**B symmetrically with respect to the second bending slider **711** equalizes the force applied to the second bending slider **711** and thus providing smooth movement thereof.

Two shafts **702** and **703**, disposed further toward the tip, each have the pipe **731** inserted therethrough. The pipe **731** and the second bending wires **316**A and **316**B are inserted through the shafts **702** and **703** disposed side by side. The shafts **702** and **703** each have a retainer member **741** at the base end. Another pipe **742** is inserted from the tip through the retainer member **741**. A pipe **731** and a second bending-wires **316**A and **316**B are passed through the pipe **742**. The tip of the pipe **742** is supported by a coil-receiving casing **743**. The coil-receiving casing **743** is screwed in the hole of a cylindrical pusher **744** and fixed there. An end portion of a coil spring **745** makes contact with the base end of the pusher **744**. The other end portion of the coil spring **745** is butted against the retainer member **741**. The pusher **744** is urged by the coil spring **745** toward the tip. In response to excessive force that draws the second bending wires **316**A and **316**B, a force that relatively moves a coil sheath **747** to an operator's hand is applied and thus, the coil spring **745** is compressed via the pusher **744**. The coil spring **745** that is preset to a length exerting a predetermined force begins to contract if the preset force is overreached. Since the second bending wires **316**A and **316**B can further be drawn in accordance with the contraction of the coil spring **745**, an excessive force is not applied to the second bending wires **316**A and **316**B. A force applied to the second bending wires **316**A and **316**B will never increase rapidly as long as the coil spring **745** can be contracted if an excessive force is applied and therefore, the second bending wires **316**A and **316**B will never be cut since overload mass is curbed. Meanwhile, the coil spring **745** is compressed by a pusher retainer **746** screwed from the tips of the shafts **702** and **703**. Since the initial position of the pusher **744** can be adjusted in accordance with the compression mass of the pusher retainer **746**, differences in rigidity and bending force based on the coil springs **745** can be adjusted.

Furthermore, only the second bending wires **316**A and **316**B are extracted from the pipe **742**. The second bending wires **316**A and **316**B are inserted through the pusher retainer **746** in the coil-receiving casing **743** and introduced through the connection sheath **515** together with the coil sheath **747** to reach to the second bending part **308**. The base end of the coil sheath **747** is brazed to a tubular coil receiver **748** and fixed there in the coil-receiving casing **743**. A coil-receiver-retainer **749** is screwed from the tip through the coil-receiving casing **743**. The coil-receiver-retainer **749** rotatively locking the coil receiver **748** prevents the coil sheath **747** from being removed from the coil-receiving casing **743**, thereby preventing the pusher retainer **746** from being twisted. The lengths of the second bending wires **316**A and **316**B corresponding to the coil sheath **747** may sometimes have an assembly error, and such an error may sometimes be caused by the stretching of the second bending wires **316**A and **316**B. Adjusting the screwing amount of the coil-receiving casing **743** relative to the pusher **744** can correct the error.

As illustrated in FIGS. **13** and **14**, a channel **801** for passing a procedure instrument **504**A therethrough is built in the central shaft **701**. The channel **801** has, in order from the base end, a retainer **802** that accommodates the procedure instrument **504**A, a coil spring **803** inserted between the retainer **802** and the tip section **571**A, and an extendable pipe **804** disposed in the coil spring **803**. A hole **802**A is formed in the center of the retainer **802**. The hole **802**A serves as an entrance for inserting the procedure instrument **504**A therefrom. The hole **802**A is a tapered hole where the opening diameter increases toward the base end. The hole **802**A having a funnel shape facilitates the insertion of a distal end of an insertion section **507**A of the procedure instrument **504**A. The extendable pipe **804** has three pipes **805**, **806**, and **807** each of which are different in diameter. These pipes are disposed coaxially. A removal stop **808** is attached to the pipes **805** and **806**. A stopper **809** locked to the removal stop **808** is attached to each pipe **806** and **807**. That is, the extendable pipe **804** becomes the shortest when three pipes **805**, **806**, and **807** substantially overlap. Extending each pipe **805**, **806**, and **807** and locking the stopper **809** to the removal stop **808** allows the extendable pipe **804** to be the longest. While the drawings illustrate the compressed state of the coil spring **803**, the coil spring **803** restores under the no-load condition. The retainer **802** moves to the vicinity of a shaft **701** and to the vicinity of the distal end of the piston **715**. Since the retainer **802** is disposed at the base end of the shaft **701** unless the procedure instrument **504**A is not inserted, the insertion section **507**A of the procedure instrument **504**A can be inserted easily. The retainer **802** is pushed by the tip portion of the operation section **506**A of the procedure instrument **504**A to be forwarded to the position illustrated in FIG. **13** when the procedure instrument **504**A is inserted. It should be noted that the extendable pipe **807** is not limited to a triple-pipe structure.

A space for passing the procedure instrument **504**A therethrough is provided in a tip section **571**A that joins three shafts **701**, **702**, and **703**. An airtight valve **811** is provided on a path into which the procedure instrument **504**A is inserted and thus, the airtight condition inside of the body subjected to a medical operation can be maintained even if the procedure instrument **504**A is removed during the medical operation. The airtight valve **811** is made of, for example, a rubber sheet disposed to seal a hole **571**B that communicates with the shaft **701**. Formed to the rubber sheet is a notch into which an insertion portion of the procedure instrument **504**A can be inserted. Passing the procedure instrument **504**A therethrough necessitates opening the notch. Removing the procedure instrument **504**A closes the notch, thereby maintaining the airtight condition. A retainer **812** is used to fix the airtight valve **811**. Fixing the retainer **812** onto the tip section **571**A by screws facilitates exchanging the airtight valve **811** made of a rubber sheet. Meanwhile, the procedure instrument **504**A is introduced into the body through a hole **812**A formed in the retainer **812**. Forming a hole **812**A so as to be tapered toward the tip facilitates the insertion of the procedure instrument **504**A.

The configuration of the second operation unit **530**B is explained.

The second operation unit **530**B has a symmetric configuration to the first operation unit **530**A with respect to the horizontal center line of the operation section **520**. A symbol

"B" is added to some components included in the operation unit **530**B to distinguish them from those of the first operation unit **530**A.

A procedure instrument **504**A inserted through the operation section **520** will be explained next. Although only the procedure instrument **504**A will be explained here, it should be noted that the procedure instrument **504**B has the same configuration. An end of each procedure instrument **504**A and **504**B may be a high-frequency knife, a puncture needle, a snare, a clip, or additional forceps.

As illustrated in FIG. **15**, a treatment section **505**A (see FIG. **1**) and an operation section **506**A both provided to the tip of the procedure instrument **504**A are joined by an elongated flexible insertion section **507**A. The operation section **506**A has a main body section **911** having a cam **910** at the tip thereof. A slider **912** that drives the treatment section **505**A is attached at the base end of the main body section **911** rotatively in the axial line direction. In addition, a finger-hook ring **913** is attached to the base end of the main body section **911**.

As illustrated in FIG. **16**, a ring **913** is joined to the main body section **911** via an E ring **915**. Operability is desirable since the ring **913** can be rotated by the E ring **915** around the axial line. It should be noted that a rubber-made protection member **916** may be used to be fitted to the inside of the ring **913** as illustrated in FIGS. **88** and **89**. A groove **916**A detachable from the ring **913** is formed on an outer periphery of the protection member **916**. The use of rubber eases pain on fingers during operation. In addition, a detachable configuration is superior in maintaining cleanliness and sterilization. Making the protection member **916** of for example, a silicone rubber, imparts chemical resistance and sterilization.

As illustrated in FIGS. **5** and **15**, the tip portion of the cam **910** is a taper where an opening diameter decreases. When a taper surface **910**A is inserted through the operation stick **531**A, the taper surface **910**A serves for pushing up the piston **715** and pressing the channel **801**. The outer diameter of the cam **910** is substantially the same as the inner diameter of the shaft **701** so that the cam **910** is slidable on the shaft **701**. Four blade sections **921** extending in the axial line direction are provided to the base end of the cam **910**. As illustrated in FIG. **19**A, each blade section **921** is provided only on the outer periphery of the cam **910**. A side surface **921**A in the circumferential direction forms a tilted and curved surface from the center toward radially outward.

In addition, as illustrated in FIGS. **19**B and **20**, a slope **921**C directed to the tip together with a gap surface **921**B standing in a radial direction may be formed on the outer periphery of the tilted side surface **921**A of the cam **910**. A gap **921**D between the tilted side surface **921**A and the outer periphery of the cam **910** is smoothly resolved by the slope **921**C. A side surface **921**E disposed opposite to the side surface **921**A in the blade section **921** has a space greater than the diameter of the piston **715** between the side surface **921**A of another blade section **921** adjacent in the circumferential direction and the side surface **921**E. The side surface **921**E is tilted in the direction the same as the tilting direction of the side surface **921**A. The tilting direction of the side surface **921**E is significant, i.e., forms a steep surface.

A main body section **911** is screwed into an inner hole of the cam **910** and fixed there. The outer diameter of the main body section **911** including a part inserted into the cam **910** and a stopper **922** having an increased diameter may be reduced gradually toward the base end. That is, FIG. **15** shows an example in which a diameter d**2** at the base end is smaller than the diameter d**1** at the tip. An operation section **506**A of the hole **571**B has a play relative to the operation stick **531**A to prevent the main body section **911** from pushing up the piston **715** even if the operation section **506**A is tilted or bent. Also, the tip of the piston **715** protruding into the shaft **701** is configured to have a correlation with the second groove **719** so that a space is formed between the piston **715** and the second groove **719**. Thus, the piston **715** is prevented from interfering with the main body section **911** and therefore, the forward movement or retracting movement of the procedure instrument **504**A can be smooth. In addition, the stopper **922** makes contact with a ratchet base **712** when the procedure instrument **504**A is inserted through the operation stick **531**A and regulates the procedure instrument **504**A to prevent it from being pushed further.

As illustrated in FIG. **21**, a pipe **931** is fixed to a slider **912**. An operation wire **932** for driving the treatment section **505**A is passed through the pipe **931**. The base end of the operation wire **932** and the base end of the pipe **931** are locked to the slider **912** by an engagement member **933**. The pipe **931** passing through a slit **911**A of the main body section **911** is extendably supported by a resin-made pipe retainer **934**. An operation wire **932** passing through another pipe **935** fixed to the pipe retainer **934** is extracted and enters an intermediate coupling **941** together with the pipe **935**, and is inserted into a metal-made single-layered coil **942** therein. Isolation is imparted to the pipe **935** by coating it with a thermally-contracting tube.

As illustrated in FIG. **22**, a coil receiver **943**, to which the base end of the single-layered coil **942** is fixed, is housed in the base end of the intermediate coupling **941**. The tip of the previously described pipe **935** is inserted into the coil receiver **943**. A diameter-contracting section **941**A is provided to the intermediate coupling **941** to prevent the coil receiver **943** from being removed toward the tip. The single-layered coil **942** is inserted into a multi-layered coil **951** farther toward the tip than the diameter-contracting section **941**A. The multi-layered coil **951** is configured to have more than three coils disposed coaxially. For example, an innermost layer coil and an outermost layer coil are wound in the same direction, and an intermediate-layer coil is wound in the opposite direction in the case of a three layer structure. This results in that rotating of the innermost layer coil and the outermost layer coil in the coil-loosening direction tightens the intermediate-layer coil, thereby causing the intermediate layer coil to interfere with the innermost layer coil. Thus, the rotation torque is transferred to the treatment section **505**A at the tip. Rotating in the opposite direction causes the loosening intermediate layer coil to interfere with the outermost layer coil, thereby transferring the rotation torque to the treatment section **505**A. In addition, using a metal-made multi-layered coil **951** improves the transferred rotation torque. A resin-made coil may be used for obtaining insulation.

A coil receiver **952** is brazed to the multi-layered coil **951**. The coil receiver **952** is slidably inserted through a longitudinal groove **941**B formed on the insulative intermediate coupling **941**. Accordingly the multi-layered coil **951** can engage with the intermediate coupling **941** in the rotative direction, but not in the forward direction or the retracting direction. Meanwhile, a resin-made removal stop **953** is attached to the tip of the intermediate coupling **941**. Since the removal stop **953** regulates the protrusion of the coil receiver **952**, the multi-layered coil **951** will never be removed from the intermediate coupling **941**. Also, the coil receiver **952** will never make contact with the main body section **911**. This configuration will not affect the length of the multi-layered coil **951** even if the single-layered coil **942** contracts or extends during a medical operation.

Also, the single-layered coil **942** can be brazed to the coil receiver **943** that is slid toward the base end and extracted from the intermediate coupling **941** after brazing the multi-layered coil **951** to the coil receiver **952**. Meanwhile, the intermediate coupling **941** should preferably be made of high heat-resistance resin, e.g., PEEK (polyetheretherketone) taking the high temperature applied during the brazing operation into account.

The outer periphery of the multi-layered coil **951** extracted from the intermediate coupling **941** is coated by an insulative tube **954**. A fluoro resin-made insulative tube **954** has lower sliding friction, thus providing desirable rotation. The isolated and coated multi-layered coil **951** passing through a winding-protection pipe **955** is extracted from a hole **910**C formed at the tip of the cam **910**.

The main body section **911** should preferably be made of a metal material taking durability into account. In this case, providing insulation to the operation section **506**A realizes a procedure instrument **504**A for use in a medical operation with a high-frequency apparatus. Therefore, the use of a resin in the removal stop **953**, intermediate coupling **941**, thermally-contracting tube of the pipe **935**, pipe retainer **934**, and slider **912** reliably isolates the main body section **911** from the operation wire **932** and coils **942** and **951**. This results in using high-frequency waves with the procedure instrument **504**A such as an incision knife or high-frequency forceps. Apparatuses of this type can be used compatibly. Insulation coating onto the multi-layered coil **951** may not be necessary unless the procedure instrument is of a high frequency application-type apparatus. In this case, increasing the thickness of the multi-layered coil **951** corresponding to the thickness of the thermally contracting tube for use as a coating will provide a more rotative procedure instrument. The thickness of the thermally contracting tube utilized for the single-layered coil **942** will provide significantly more resistance against compression or expansion.

Consequently, steps for carrying out operations using the medical treatment endoscope **501** will be explained. Meanwhile, a case will be explained as follows where an endoscope is introduced from a mouth as a natural orifice of a patient, a procedure instrument is introduced from an opening formed in a stomach into an abdominal cavity to grasp tissue. It should be noted that operations can be carried out through another organ or another path. Although we concentrate on the procedure instrument **504**A and the first operation unit **530**A in the explanation, the procedure instrument **504**B and the operation unit **530**B can be used independently because they are mere symmetric components.

Two procedure instruments **504**A and **503**B are inserted into the medical treatment endoscope **501**. The procedure instrument **504**A is inserted into the first operation unit **530**A. As schematically illustrated in FIG. **23**, when the procedure instrument **504**A is not inserted yet, the piston **715** provided to the ratchet base **712** at the tip of the first operation stick **531**A engages with the first groove **718** of the connection plate **713** and locks the connection plate **713**. Locking the connection plate **713** prevents the second bending slider **711** from moving since the ratchet base **712** is unmovable. This corresponds to a position where the second bending part **308** becomes straightened. That is, the second bending part **308** is always straightened in the medical treatment endoscope **501** when the procedure instrument **504**A is inserted. As illustrated in FIG. **24**, forwarding the operation section **50**A into the first operation stick **531**A pushes up the piston **715** with the taper surface **910**A of the cam **910** at the tip of the operation section **506**A. As illustrated in FIG. **25**, the piston **715** being capable of moving up the inclination surface **718**A of the first groove **718** of the connection plate **713** allows the second bending slider **711** to be controlled in the direction indicated by an arrow shown in the drawing.

As illustrated in FIG. **5**, the insertion section **507**A of the procedure instrument **504**A passing through the channel **801** is introduced into a channel in the connection sheath **515**. The insertion section **57**A further passing through the endoscope insertion section **503** is introduced to the tip of the first arm member **302**A. Similarly, the procedure instrument **504**B inserted into the operation stick **531**B of the operation unit **530**B is disposed at the tip of the second arm member **303**A.

After closing the arm sections **302**A and **303**A having the procedure instruments **504**A and **504**B previously passing therethrough, the endoscope insertion section **503** is introduced into a body cavity from an opening previously formed in a stomach wall. In addition, the endoscope insertion section **503** may be passed through an overtube previously inserted into a body.

A section to be treated is confirmed while observing with a monitor an image obtained by an endoscopic image-pickup device provided to the tip of the endoscope insertion section **503**. At this time, a first operator manipulates an angle knob **512** of the endoscope insertion section **502** and bends a third bending part **203**B. Furthermore, a second operator bends the second bending part **308** and the first bending part **306** if necessary.

Bending the second bending part **308** necessitates retracting the second bending slider **711** provided to the operation sticks **531**A and **531**B. As illustrated in FIG. **25**, retracting the second bending slider while the piston **715** is elevated causes the engagement chip **717**A of the piston **715** to go up the inclination surface **718**A, thereby causing the connection plate **713** to slide on the piston **715** as illustrated in FIG. **26**. The second bending slider **711** which cannot be farther retracted after the piston **715** is housed in the second groove **719** as illustrated in FIG. **27**. The second bending part **308** as illustrated in FIG. **1** bends at this position, causing the first arm member **302**A to open. In addition, since the second groove **719** is shallower than the first groove **718**, a space Ss is formed between the cam **910** and the main body section **911** of the operation section **506**A when the piston **715** engages with the second groove **719**. Absence of sliding friction between the main body section **911** and the piston **715** allows smooth extension and retraction of the main body section **911**.

Furthermore, bending the first bending part **306** necessitates tilting the operation sections **506**A and **506**B of the procedure instruments **504**A and **504**B while observing the endoscopic image.

As illustrated in FIG. **4**, tilting the operation section **506**A upward relative to the operator causes the rotation shafts **564**A and **565**A of the first rotation mechanism **561**A to rotate in accordance with the tilting angle. The rotation of the sprocket **595** attached to the rotation shafts **546**A and **565***a* causes extension and retraction of the first bending wires **315**A and **315**B attached to the chain **622**, thereby bending the first bending part **306** upward. In contrast, tilting the operation section **506**A downward relative to the operator causes the rotation shafts **564**A and **565**A of the first rotation mechanism **561**A to rotate in the direction reverse to the upward tilting direction in accordance with the tilting angle. The reverse rotation of the sprocket **595** attached to the rotation shafts **546**A and **565***a* causes extension and retraction of the first bending wires **315**A and **315**B attached to the chain **622**, thereby bending the first bending part **306** downward.

Tilting the operation section **506**A in a right-hand direction relative to the operator causes the rotation shafts **584**A and

585A of the second rotation mechanism 581A to rotate in accordance with the tilting angle. The rotation of the sprocket 595 attached to the rotation shafts 584A and 585A causes extension and retraction of the first bending wires 315C and 315D attached to the chain 622, thereby bending the first bending part 306 in the right-hand direction. In contrast, tilting the operation section 506A in a left-hand direction relative to the operator causes the rotation shafts 584A and 585A of the second rotation mechanism 581A to rotate in the reverse direction in accordance with the tilting angle. The rotation of the sprocket 595 attached to the rotation shafts 584A and 585A causes extension and retraction of the first bending wires 315C and 315D attached to the chain 622, thereby bending the first bending part 306 in the right-hand direction.

Since the second rotation mechanism 581A is not driven when the first rotation mechanism 561A is driven, and the first rotation mechanism 561A is not driven when the second rotation mechanism 581A is driven, each bending can be obtained without being affected by these rotation mechanisms. Meanwhile, tilting the operation section 506A drives the first and second rotation mechanisms 561A and 581A in accordance with the tilting ratio with respect to the vertical and horizontal directions, thereby bending the first bending part 306 diagonally in a direction the same as the tilting direction of the operation section 506A. Since the center or barycenter of the operation stick 531A in the longitudinal direction is configured to substantially coincide with the positions of the rotation shafts 546A, 565A, 584A, and 585A, the operation stick 531A and the operation section 506A of the procedure instrument 504A during hands-free operation by the operator will not descend with gravity; therefore, erroneous operation can be prevented.

A necessary force is optimized to operate the first bending part 306 by means of a non-electric wire-assisted operation. To be more specific, a portion of the operation stick 531A operated by the operator who inputs a force is decelerated by separating and offsetting the portion from the rotation shafts 546A, 565A, 584A, and 585A. As illustrated in FIG. 6, since a deceleration ratio corresponding to a ratio between a distance Lr an a radius Rs of the sprocket 595 is obtained, the bending operation can be carried out with a small force while downsizing the operation section 520. In this case the distance Lr indicates the length between the base end section of the operation section 506A of the procedure instrument 504A. In addition, the deceleration enhances resolution, thereby enabling accurate bending operation.

As illustrated in FIGS. 5 and 6, since the point of the second rotation mechanism 581A to which a force is transmitted from the first operation stick 531A is offset toward the tip relative to the rotation shafts 564A and 565A such as a roller bearing 572A as illustrated in FIG. 6, the force necessary at the transfer position is decreased, and friction among components can be reduced. This decreases the rigidity required for components used there and obtains a small and lightweight operation section 520. Also, the use of the ball roller 572A at the point of the second rotation mechanism 581A to which the force is transferred from the first operation stick 531A reduces the friction due to the second rotation mechanism 581A when rotating the first operation stick 531A vertically, thereby reducing the necessary force for the vertical operation.

Grasping tissue necessitates adjusting the position of a forceps member that is opened or closed by the operation section 506A of the procedure instrument 504A. For example, pushing the operation section 506A into the first operation stick 531A causes the treatment section 505A to protrude further from the first arm member 302A. Also, retracting the operation section 506A from the first operation stick 531A causes the treatment section 505A to be retracted into the first arm member 302A. As illustrated in FIG. 28, since this state of the cam 910 is hooked on the piston 715, the procedure instrument 504A will not be undesirably removed from the first operation stick 531A.

Adjusting the direction of the procedure instrument 504A around the axial line necessitates the main body section 911 of the operation section 506A to rotate around the axial line. Thus, rotational torque is input into the multi-layered coil 951 that is engaged to the intermediate coupling 941 in the rotational direction as illustrated in FIGS. 21 and 22. In the multi-layered coil 951, two coils adjacent to each other in a radial direction interfere with each other while they are tightened or loosened based on their combination of the winding direction and the rotational direction of the operation section 506A and thus, rotational torque is transferred. Since the treatment section 505A is fixed to the tip of the multi-layered coil 951, the transferred rotational torque rotates the treatment section 505A around the axial line. The rotation in the vicinity of the operator's hand is stopped after confirming that a desirable direction is obtained by means of an endoscopic image.

The slider 912 is forwarded after adjusting the direction and position of the treatment section 505A. The operation wire 932 moves an opening-and-closing mechanism of the treatment section 505A to open a pair of forceps members. The single-layered coil 942 receives an extension force generated by pushing the operation wire 932. The extension force is not applied to the multi-layered coil 951 because the multi-layered coil 951 is not engaged with the operation section 506A in the extension and retraction directions. This allows the treatment section 505A to be adjusted even if the forceps members are opened. Consequently, retracting the slider 912 causes the forceps members to close and grasp tissue. The compression force generated temporarily is received by the single-layered coil 942.

The procedure instruments 504A and 504B are retracted from the medical treatment endoscope 501 after completing necessary treatments. The procedure instruments 504A and 505B are also retracted from the medical treatment endoscope 501 in order to exchange procedure instruments necessary for a treatment. As illustrated in FIG. 28, the operation section 506A is rotated around the axial line after the cam 910 abuts the piston 715. The piston 715 is pushed up along the tilted side surface 921A of the blade section 921 of the cam 910. As illustrated in FIG. 29, providing the tilted side surface 921A enables pushing up of the piston 715 with a small force. Meanwhile, as illustrated in FIGS. 19 and 20, the procedure instrument 504A will never be rotated excessively if the gap surface 921B is provided. Furthermore, providing the slope 921C facilitates offsetting the piston 715 from the cam 910 in an axial line direction (thrust direction), thereby removal is easy. Meanwhile, it is preferable that the entire cam 910 be made of a metal in view of breakage protection. In addition, the cam 910 may be made of POM (polyoxymethylene) that has desirable slidability in view of facilitating operation in extension and retraction operations in the first operation stick 531A.

However, the treatment sections 505A and 505B cannot be removed if the second bending part 308 of the arm sections 302A and 303A is opened, and the engagement of the piston 715 and the cam 910 can be released. The piston 715 pushed up by the cam 910 in the operation section 520 is configured to automatically restore the second bending part 308 to a straightened state. That is, pushing up the piston 715 and

releasing the engagement with the second groove **719** retract the second bending slider **711** with tension applied by the second bending wires **316**A and **316**B and a resilience of the coil spring **745**. This results in causing the second bending part **308** to restore into the straightened state. In addition, a resilient part like a spring **792** as illustrated in FIG. **13** may be added to prevent energetic restoration of the second bending slider **711**. Consequently, the medical treatment endoscope **501** is removed from the body after removing the procedure instrument **504**A.

Next, a modified example of the present embodiment will be described as follows.

As illustrated in FIG. **30**, operation sections **1001**A and **1001**B each for operating the second bending slider **711** may be fixed to the bracket **551**A and a bracket **551**B in parallel with each axial line of the operation sticks **531**A and **531**B. The operation sections **1001**A and **1001**B each have an extendable and retractable slider. Moving the slider causes the wire in a coil sheath **1002** to be extended or retracted. As illustrated in FIG. **31**, the coil sheath **1002** is fixed to the coil receiver **1003** attached to the ratchet base **712**. A pipe **1004** is passed through the coil receiver **1003**. The pipe **1003** passing through the coil sheath **1002** is rotatively engaged with the second bending slider **711** via the wire receiver **1005** together with the second bending wires **316**A, **316**B. A wire **1006** joined to the sliders of the operation sections **1001**A and **1001**B is passed through the pipe **1004**. Retracting the sliders of the operation sections **1001**A and **1001**B moves the wire **1006**, thereby drawing the second bending slider **711** and opening the second bending part **308**. In this configuration, the operation section **520** can be downsized and thus, operation of the second bending part **308** can be facilitated. Also, this configuration prevents the movement of the operation sticks **531**A and **531**B during the operation of the second bending part **308**. Thus, grasped tissue will never be moved unexpectedly.

As illustrated in FIG. **32**, the base end of the cam **910** may be an inclination surface **1010**. Drawing the procedure instrument **504**A from the first operation stick **531**A causes the piston **715** to move up the inclination surface **1010**, thereby removing the procedure instrument **504**A. The procedure instrument **504**A cannot be removed with a force based on the retraction of the procedure instrument **504**A toward the operator during a treatment. Further additional force will provide retraction. In this configuration, the procedure instrument **504**A can be removed without rotating the operation section **506**A.

In addition, operations for significant rotations of the procedure instruments **504**A and **504**B will be explained with reference to FIGS. **33** and **34**. This includes cases where we intend to adjust the treatment section **505**A in the optimum direction to grasp tissue. As illustrated in FIG. **33**, the slider **912** is held with an index finger and a middle finger. The hand-held state of the slider **912** is rotated in a clockwise direction by 90°. The index finger and the middle finger are withdrawn from the slider **912** after rotating the slider **912** and the main body section **911** to the positions illustrated in FIG. **34**. The hand not holding the slider **912** is rotated in a counterclockwise direction by 90° to the position illustrated in FIG. **33**. This state of the insertion section **507**A of the procedure instrument **504**A has friction relative to channels in a first operation stick **531**A and the second arm member **302**A. To be more specific, the channels are a channel **801**, a channel in the connection sheath **515**, and a channel in the endoscope insertion section **503**. Therefore, the insertion section **507**A will not rotate in the counterclockwise direction with a mere touch with the slider **912** and thus, its disposition is maintained. Repeating the above steps enables 90° feed operation of the procedure instrument **504**A.

As illustrated in FIG. **35**, the medical treatment endoscope **501** may be passed through the overtube **90**. The first operator handling the endoscope insertion section **502** conducts ordinary endoscopic operation with his/her left hand while operating the endoscope insertion section **503** and overtube **90** with his/her right hand. The use of bending of the overtube **90** improves the approachability to the object position in the abdominal cavity.

Second Embodiment

In a medical treatment endoscope of the present embodiment, a channel for inserting a procedure instrument therethrough is detachable in the operation section.

As illustrated in FIG. **36**, a medical treatment endoscope **1300** according to the present embodiment is provided with the endoscope insertion section **502**, the endoscope insertion section **503**, and the operation section **1102** that are the same as those of the first embodiment. Wires for maneuvering the two arm sections **302**A and **302**B extending from the endoscope insertion section **503** passing through the connection sheath **515** are connected to a wire unit detachable from the operation section **1350**. Three wire units are provided to each arm section and include two first wire units having a vertically moving first wire unit **1301** and a horizontally moving second wire unit **1302**; and a second-bending-wire unit **1303**. Therefore, the present embodiment is provided with six wire units in total, i.e. wire units **1301**A, **1302**A, and **1303**A that are connected to the first arm section **302**A and wire units **1301**B (not shown in the drawing), **1302**B, and **1303**B that are connected to the second arm section **302**B.

The operation section **1350** having substantially the same structure as the operation section **520** of the first embodiment includes a first operation unit **1350**A for maneuvering the first arm section **302**A; and a second operation unit **1350**B for maneuvering the second arm section **302**B.

The first wire units **1301**A and **1301**B are attached to first rotation mechanisms **1351**A and **1351**B of the operation units **1350**A and **1350**B, not shown in the drawing, respectively. The second wire units **1302**A and **1302**B are respectively attached to second rotation mechanisms **1352**A and **1352**B of each operation unit, not shown in the drawing. In the operation units **1350**A and **1350**B, the second bending wire units **1303**A and **1303**B are attached detachably to second bending-operation-mechanisms **1353**A and **1353**B, not shown in the drawing, provided between the first rotation mechanism and the second rotation mechanism.

The second-bending-operation mechanisms **1353**A and [B]**1353**B are connected to sliders **1355**A and **1355**B provided to operation sticks **1354**A and **1354**B having procedure instruments inserted through the arm sections **302**A and **302**B via transmission members, e.g. a wire. (details thereof will be explained later). Drawing the sliders **1355**A and **1355**B proximally causes the second bending **308** of the arm section to bend. Finger hook sections **1356** formed by bending a plate member are provided to the sliders **1355**A and **1355**B so that operation while grasping the operation sticks **1354**A and **1354**B by hooking fingers thereto can be conducted.

Accordingly, maneuvering the operation sticks **1354**A and **1354**B cause the wires connected to the wire units **1301** and **1302** via rotation mechanisms **1351** and **1352** to be operated, thereby permitting operation of the arm sections **302**A and **302**B.

An operation stick (hereinafter called simply a "stick") and the structure of a channel will be explained next. It should be

noted that the sticks **1354**A and **1354**B have the same structure in the following explanation provided in associate with the stick **1354**A as an example.

FIG. **37** is a perspective view showing the stick **1354**A. It should be noted that FIG. **37** is a perspective view facilitating visualization of the inside of the stick **1354**A. The stick **1354**A is provided with a tubular main body **1357**; a slider section **1358** having a slider **1355**, provided therein, which will be explained later; and a fixture section **1359** for fixing a channel unit **1360** to the main body **1357**. The channel unit **1360** having a procedure instrument therethrough is inserted in the main body **1357** from the vicinity of the fixture section **1359** and is fixed to the fixture section **1359** detachably.

FIG. **38** is a perspective view showing the channel unit **1360** removed from the stick **1354**A. The channel unit **1360** is provided with a tubular main body **1361**; a connecting section **1362** attached to one of the ends of the main body **1361**; and a mating fixed section **1363** fixed to the fixture section **1359** of the stick **1354**A.

The channel unit **1360** is made from a material resistible to cleaning and sterilization. Specific adaptable examples are: SUS303 and SUS 304 as a metal material; and, for example, polyester, polyetheretherketone, and polyethersulphone as a resin material.

The connecting section **1362** is connected with the instrument channel which communicates with an inner cavity of the first arm section **302**A and extends to the connection sheath **515** through the endoscope insertion section **503**. It is preferable that the tip of the connecting section **1362** is made from a flexible material which can absorb a shift in distance to some extent between a distal end of the stick and the fixture position because operating the operation units **1350**A and **1350**B will vary the shift.

It should be noted that the structure of the tip of the connecting section **1362** and a method for connecting it to the instrument channel will be explained later.

The mating fixed section **1363**, which has the next smaller size than that of the fixture section **1359** of the stick **1354**A, is enclosed in the fixture section **1359** and fixed detachably. In addition, an opening **1364** for inserting a procedure instrument therethrough is provided to the mating fixed section **1363**. The procedure instrument inserted into the opening **1364** and passing through the main body **1361** and the connecting section **1362** upon entering the instrument channel can reach to the first arm section **302**A.

FIG. **39** is a cross-sectional view showing the stick **1354**A having the channel unit **1360** inserted therein. The slider section **1358** capable of sliding along the axial line of the main body **1357** is attached to an outer periphery of the main body **1357**. An operation member **1365** attached to the second bending operation mechanism **1353** is attached to the slider section **1358**. For example, the operation member **1365** is formed by a wire inserted through a metal coil, which is not shown in the drawings. Therefore, drawing the slider **1355** enables operation of the second bending of the first arm section **302**A via the second bending operation mechanism **1353**. In addition, an erroneous-operation-preventive connecting member **1366** attached to the slider section **1358** is inserted through the fixture section **1359**. The connecting member **1366** provides substantially the same function and movement as those of the connection plate **713** explained in the first embodiment, and details thereof will be explained later.

The fixture section **1359** has a release switch **1367** which releases the fixture between the stick **1354**A and the channel unit **1360**; an urging section **1368** which protrudes the channel unit **1360** when the fixture is released; an erroneous-movement-preventive section **1369** which engages with the connecting member **1366** to regulate the movement of the slider section **1358**; and a removal button **1370** used for removing the procedure instrument inserted into the channel unit **1360**.

A switching member **1367**B provided to the release switch **1367** and attached in a through-hole **1367**A provided on the upper surface of the fixture section **1359** is capable of sliding in the through-hole **1367**A.

A cylinder **1368**B inserted into a hole **1368**A provided in parallel with the axial line of the main body **1361** forms the urging section **1368**. Such a structure called a plunger is commonly known. The cylinder **1368**B urged by a spring **1368**C is configured to protrude into the inner cavity of the fixture section **1359**.

A substantial cylindrical engagement piston **1369**B inserted into a hole **1369**A provided to the bottom surface of the fixture section **1359** forms the erroneous-movement-preventive section **1369**. A spring **1369**C urges the engagement piston **1369**B upward. The hole **1369**A crosses a through-hole **1371** having the connecting member **1366** inserted therethrough substantially orthogonally. In addition, the engagement piston **1369**B is provided with a through-hole **1372** which communicates with the through-hole **1371**.

This causes the connecting member **1366** to pass through the through-holes **1371** and **1372** and protrude in the vicinity of the fixture section **1359** proximally. An upwardly-protruding engagement protrusion **1369**C provided in the through-hole **1372** of the engagement piston **1369**B is capable of engaging with an engagement groove, which will be explained later, provided to the connecting member **1366**.

On the other hand, the mating fixture section **1363** of the channel unit **1360** is provided with engagement jaws **1373** which engage with the stick **1354**A; a first piston **1374** (regulating section) synchronously moving with the erroneous-movement-preventive section **1369** to control the movement of the connecting member **1366**; and a second piston (falloff-preventive section) **1375** for preventing the inserted procedure instrument from dropping off of the channel unit **1360** erroneously.

The engagement jaws **1373** urged by a spring to protrude relative to the upper surface of the mating fixed section **1363** is designed to have dimensions which allow the engagement jaws **1373** to be enclosed fully in the hole **1373**A. In addition, the vicinity of the tip is formed to have an oblique surface which facilitates insertion of the channel unit **1360** into the stick **1354**A.

Therefore, inserting the channel unit **1360** into the stick **1354**A causes the oblique surfaces of the engagement jaws **1373** in the vicinity of the tip to make contact with the fixture section **1359**, thereby causing the engagement jaws **1373** to be pushed by the fixture section **1359** and enclosed in the hole **1373**A. The engagement jaws **1373** upon reaching the bottom of the through-hole **1367**A of the fixture section **1359** moves upward and enters the through-hole **1367**A to push the switching member **1367**B. Accordingly, the engagement between the engagement jaws **1373** and the through-hole **1367**A causes the channel unit **1360** to be detachably fixed to the stick **1354**A.

A spring prevents the first piston **1374** inserted and enclosed in the through-hole **1374**A from protruding into the inner cavity of the mating fixed section **1363** by urging the first piston **1374**. The urging force acting onto the first piston **1374** is set to be significantly weaker than that of the spring **1369**C urging the engagement piston **1369**B. The through-hole **1374**A is provided at a position which provides communication between the through-hole **1374**A and the hole **1369**A

having the engagement piston **1369**B inserted therein when the channel unit **1360** is fixed to the stick **1354**A unitarily. Therefore, fixing the channel unit **1360** to the stick **1354**A unitarily causes the first piston **1374** to make contact with the engagement piston **1369**B. In addition, the urging force of the spring **1369**C causes the first piston **1374** to protrude into the inner cavity of the mating fixed section **1363**. In addition, the lower section of the first piston **1374** pushed downward protrudes below the through-hole **1374**A allows the engagement piston **1369**B to be pushed down.

In addition, a commonly-known linear bush **1376** is attached to a part of the mating fixed section **1363**. Bearings, not shown in the drawing, rotatable in the axial line direction in the inner cavity of the linear bush **1376** can provide accurate extension and retraction movement of an inserted procedure instrument along the axial line with less significant force.

FIG. **40** shows the operation section **1350** in the vicinity of the tip in a magnified view. A channel-fixing section **1377** fixing the connecting section **1362** provided to the tip of the channel unit **1360** is provided in the vicinity of the operation section **1350**.

The rail **1378** is attached below the channel-fixing section **1377**. The rail **1378** engaging with a base **1380** fixed to an enclosure **1379** is capable of sliding in the longitudinal direction of the rail **1378** relative to the base **1380**. This allows the channel-fixing section **1377** to make extending and retracting movements of a predetermined length. Accordingly, smooth operation can be obtained since the channel-fixing section **1377** makes extending and retracting movements corresponding to vertical and/or horizontal movements of the two operation sticks **1354**A and **1354**B of the operation section **1350**.

Movement of the medical treatment endoscope having the aforementioned structure in use will be explained as follows. The channel unit explained here in the present embodiment is a sterilized non-recyclable unit **1360**A.

FIG. **41** is a perspective view showing the channel unit **1360**A. Channels formed on the outer and inner peripheries of the channel unit **1360**A are sterilized by various methods, e.g., autoclave method or a gas sterilization method, etc. A first cap **1381** and a second cap **1382** are attached to openings **1364** of the connecting section **1362** and the tubular main body **1361** respectively to maintain unsterilized condition of the channels. The first cap **1381** is set to have a diameter that allows the first cap **1381** to pass through the inner cavity of the stick **1354**A. Screw engagement is provided to the caps **1381** and **1382** attached to the channel unit **1360**. Forming the screw sections engaging with each other by a metal material improves sterilized condition of the screw sections provided by the autoclave method, etc.

To start with, the channel units **1360**A are inserted into the openings of the fixture sections **1359** of the sticks **1354**A and **1354**B. Subsequently, the engagement jaws **1373** are engaged with the through-hole **1367**A of the release switch **1367**; and the channel unit **1360**A is fixed to the stick **1354**A unitarily. The method for operating of the stick **1354**A explained as follows is to the stick **1354**B connected to the second arm section **302**B.

Subsequently, the tip of the connecting section **1362** protruding from the tip of the stick **1354**A is inserted from an opening formed in the vicinity of the base end of the channel-fixing section **1377** as shown in FIG. **42**.

FIG. **43** shows the channel-fixing section **1377** and the connecting section **1362** in a cross-sectional view. A fixed knob **1383** provided to the channel-fixing section **1377** is drawn and the connecting section **1362** is inserted. Subsequently, releasing the fixed knob **1383** upon protruding the first cap **1381** from the tip of the channel-fixing section **1377** causes the fixed knob **1383** urged by a spring to protrude inward relative to the channel-fixing section **1377** and engage with the connecting section **1362**. Accordingly, the connecting section **1362** is fixed to the channel-fixing section **1377** detachably as shown in FIG. **42**.

Subsequently, the connecting section **1362** is connected to an instrument channel **1384** extending from the endoscope insertion section **503** through the connection sheath **515**. As shown in FIG. **44**, the operation section **1350** should be covered with a drape **1304** to prevent a user from touching the unsterilized sticks **1354**A and **1354**B or the whole part of the operation section.

Subsequently, the boundary part between the first cap **1381** and the connecting section **1362** is fixed by a tape or a rubber member as shown in FIG. **45**. In addition, the outer periphery section of the first cap **1381** may be fixed by a tape or a rubber member etc. In addition, the boundary part between the second cap **1382** and the fixture section **1359** is fixed similarly. It is preferable that perforation facilitating separation thereof should be provided previously to the part corresponding to the drape **1304** fixed thereon.

As shown in FIG. **46**, the user upon separating the drape **1304** along the perforation and removing a part of the drape **1304** and the first cap **1381** together from the connecting section **1362** obtains an opening **1385**, which maintains sterilized condition, formed on the tip of the connecting section **1362**.

Subsequently, inserting a connecting member **1386** provided in the vicinity of the base end of the sterilized instrument channel **1384** into the opening **1385** and engaging the connecting section **1362** with the connecting member **1386** cause the channel unit **1360** to connect with the instrument channel **1384** in a sterilized manner as shown in FIG. **47**. A channel for inserting a procedure instrument in a sterilized condition thereinto is formed in this manner. The channel communicates from the first arm section **302**A to the mating fixed section **1363** of the channel unit **1360**A. It should be noted that warp of the instrument channel **1384** during operation of the procedure instrument is prevented since the connecting member **1386** attached to the instrument channel **1384** is capable of freely rotating around the axial line.

Subsequently, a part of the drape **1304** together with the second cap **1382** are removed and the opening **1364** of the mating fixed section **1363** is released by the same operation as that conducted to the aforementioned first cap **1381** to insert the procedure instrument. Subsequently, the procedure instrument for use inserted into the opening **1364** is protruded from the tip of the first arm section **302**A.

FIGS. **48** to **53** show the mating fixed section **1363** of the channel unit **1360**A and the erroneous-movement-preventive section **1369** of the stick **1354**A during the insertion of the procedure instrument. A procedure instrument **1305** specifically used for the medical treatment endoscope **1300** has an engagement groove **1305**A formed in the circumferential direction thereof. The engagement groove **1305**A formed to be shallower toward the base end thereof has a taper surface **1305**B. It is preferable that the engagement groove **1305**A be provided so that the tip of the procedure instrument **1305** may engage with the second piston **1375** upon inserting the tip of the procedure instrument **1305** in the vicinity of the tip relative to the second bending of the first arm section.

A first engagement section **1387** and a second engagement section **1388** provided to the connecting member **1366** are capable of engaging with the engagement protrusion **1369**D of the engagement piston **1369**B. The first engagement sec-

tion **1387** in the vicinity of the base end has a first notch **1387**A having a taper surface; and a second notch **1387**B formed deeper than the first notch **1387**A and proximal relative to the first notch **1387**A. A step **1387**C having a predetermined, for example, several millimeters of depth, is provided between the first notch **1387**A and the second notch **1387**B.

As shown in FIG. **48**, the engagement protrusion **1369**D of the engagement piston **1369**B engages with the second notch **1387**B of the first engagement section **1387** prior to the insertion of the procedure instrument **1305**. The connecting member **1366** in an attempt to draw the slider section **1358** in this state proximally cannot move proximally since the engagement protrusion **1369**D abuts to the step **1387**C. This prevents bending of the second bending of the arm section based on erroneous maneuvering of the slider section **1358** prior to insertion of the procedure instrument **1305** into the channel unit **1360**A.

It should be noted that the state of first piston **1374** making contact with the engagement piston **1369**B is urged by the spring **1369**C and protruded into the inner cavity of the mating fixed section **1363**.

The outer periphery of the procedure instrument **1305** upon inserting the procedure instrument **1305** into the channel unit **1360**A and protruding the second piston **1375** into the engagement groove **1305**A pushes the first piston **1374** downward. The first piston **1374** presses down the engagement piston **1369**B of the erroneous-movement-preventive section **1369**. Then the upper end of the engagement protrusion **1369**D moves lower than the step **1387**C. Drawing the slider section **1358** in this state proximally causes the taper surface of the first notch **1387**A to make contact with the engagement protrusion **1369**D, thereby allowing the connecting member **1366** to move across the engagement protrusion **1369**D proximally as shown in FIG. **50**. That is, bending operation of the second bending **308** is possible. This state of engagement groove **1305**A of the procedure instrument **1305** engaging with the second piston **1375** prevents erroneous retraction and drop-off of the slider section **1358** from the channel unit **1360**A while operating the slider section **1358**.

Drawing the slider section **1358** proximally and engaging the second engagement section **1388** of the connecting member **1366** with the engagement protrusion **1369**D as shown in FIG. **51** cause the slider section **1358** to be supported by the engagement protrusion **1369**D, thereby maintaining the bending state of second bending **308**.

Further advancing the procedure instrument **1305** as shown in FIG. **52** causes the taper surface **1305**B to press down the second piston **1375** and the tip of the procedure instrument **1305** to protrude from the first arm section **302**A, thereby manipulation is ready to be carried out. This state enables extension and retraction of the procedure instrument **1305** in the axial line direction. This state of first piston **1374** urged downwardly by a spring as shown in FIG. **52** is enclosed in the through-hole **1374**A since the engagement piston **1369**B is moved downwardly. Therefore, a friction force is not produced between the first piston **1374** and the procedure instrument **1305**.

Subsequently, desirable manipulation is carried out by the same operation as that of the first embodiment by protruding the procedure instrument from the tip of the second arm section **302**B.

Removal of the procedure instrument after ending the manipulation necessitates pressing the removal button **1370** (see FIG. **39**). As shown in FIG. **53**, pressing the removal button **1370** causes a first protrusion **1389** and a second protrusion **1390** that protrude relative to the outer periphery of the channel unit **1360** to be pushed down. Pressing down the first protrusion **1389** and the second protrusion **1390** extending from the first piston **1374** and the second piston **1375** respectively causes the first piston **1374** and the second piston **1375** to be pushed down as shown in FIG. **54**. The disengagement between the second piston **1375** and the procedure instrument **1305** consequently enables removal of the procedure instrument **1305**. Simultaneously, the first piston **1374** pushes down the engagement protrusion **1369**D of the engagement piston **1369**B and disengages the protrusion **1369**D of the engagement piston **1369**B from the connecting member **1366**. The tension of the second-bending-operation wire causes the slider section **1358** to move ahead.

Manipulation using another procedure instrument may be maintained by insertion of the corresponding procedure instrument in accordance with the aforementioned method. Operations after ending all the manipulations will be explained as follows.

After removing the procedure instrument **1305**, a lever **1386**A (see FIG. **47**) of the connecting member **1386** of the instrument channel **1384** is maneuvered to disengage the instrument channel **1384** from the channel unit **1360**. Subsequently pulling up the fixed knob of the channel-fixing section **1377** causes the connecting section **1362** to be removed from the channel-fixing section **1377**.

Subsequently pressing the release switch (see FIG. **39**) **1367** causes the engagement jaws **1373** of the mating fixed section **1363** to be disengaged from the through-hole **1367**A of the release switch **1367**. Synchronously, the channel unit **1360**A can be removed easily since the urging section **1368** pushes the channel unit **1360**A proximally and the mating fixed section **1363** is exposed from the base end of the stick **1354**A. The removed channel unit **1360**A is discarded instantaneously, or cleaned and sterilized for reuse.

The medical treatment endoscope **1300** according to the present embodiment is detachable from the sticks **1354**A and **1354**B for operating the procedure instrument **1305** via the arm section and the channel unit **1360** including the channel for passing the procedure instrument therethrough. Therefore, manipulations in more sanitary conditions, that maintain the sterilized state of the channels can be conducted by rendering the channel unit **1360** a sterilized throwaway unit or by sterilization for reuse.

The number of operation units may vary desirably and correspond to the number of the arms of the arm section in contrast to the aforementioned embodiment explaining the example in which the operation section is provided with the first operation unit and the second operation unit. Also, a configuration may be free from the second-bending-wire unit and the third mating attachment section in a case where the arm section is not provided with the second bending part **308**.

In addition, the position of the releasing switch is not limited to the present embodiment explaining an example attaching the release switch **1367** onto the upper surface of the fixture section **1359**. An example thereof is as follows.

FIG. **55** is a bottom plan view showing the stick **1391** and the channel unit **1392** in accordance with a modified example of the present embodiment. FIGS. **56** and **57** are cross-sectional views along the lines A-A and B-B in FIG. **55** respectively.

As shown in FIGS. **55** to **57**, the release switch **1393** is separately disposed on the bottom surface of the fixture section **1359** above the axial line in the longitudinal direction of the stick **1391** having the connecting member **1366** attached thereto. In addition, an oblique surface is not formed to the tip of the engagement jaws **1394** provided to the channel unit **1392**. Alternatively, forming an oblique surface on an inner

wall **1395**A making contact with the engagement jaws **1394** in an opening **1395**, into which the channel unit **1392** is inserted, facilitates insertion of the channel unit **1392** into the stick **1391**. This configuration providing smooth insertion of the channel unit **1392** into the stick **1391** can also support the both components unitarily.

Also, providing two finger-hook sections **1356** as shown in FIG. **55** permits two-hand operation to the slider section, thereby providing easy operation to a not so muscular user.

In addition, another modified example as shown in FIG. **58** may be provided in which a connection section **1396** of the channel unit may be screwed into a connection member **1397** of the instrument channel formed like a cap in place of the present embodiment explaining an example engaging the connection member provided in the vicinity of the base end of the instrument channel with the connecting part of the tip of the channel unit. Accordingly, possibility of contamination can be reduced more significantly since an increased-diameter section of the connection member **1397** can cover an inner surface **1304**A of the drape **1304** which will be exposed and contaminated when the drape **1304** is torn.

In addition, inserting the connection section **1396** into, in this case, the channel-fixing section **1377** causes a shaft **1383**A connected to the fixed knob **1383** to engage with a groove **1396**A provided on the outer periphery of the connection section **1396**. This prevents the connection section **1396** from being removed from the channel-fixing section **1377**.

Rotating to remove this state of first cap **1381** based on a screw engagement method causes the connection section **1396** to rotate so as to connect to the procedure instrument channel. Accordingly, the shaft **1383**A enters one of a plurality of holes **1396**B provided to the groove **1396**A, thereby immobilizing the connection section **1396** to be fixed to the channel-fixing section **1377** (see FIG. **59**). Therefore, attaching the connection member **1397** to the connection section **1396** by using the screw engagement method is in no need of fixing the connection section **1396** manually to prevent the rotation thereof, thereby facilitating the connection of both components. It should be noted that the hole **1396**B does not have to have a through hole formed therethrough as long as the hole **1396**B has a recessing shape (recessed section) which is capable of engaging with the shaft **1383**A. For example, the hole **1396**B may have a bottom having a recessed section.

In addition, as shown in modified examples shown in FIGS. **60**A and **60**B, a first cap **1398** and a second cap **1399** may have fixture sections **1398**A and **1399**A which have a reduced diameter on a part of the outer peripheries respectively. Accordingly, the drape **1304** can be fixed by, for example, a tape, easily, and a part of the drape **1304** can be removed together with the caps **1398** and **1399**.

Third Embodiment

In the medical treatment endoscope according to the present embodiment, a second piston for preventing removal of the procedure instrument **1305** is disposed in the vicinity of a tip relative to a first piston linking with an erroneous-movement-preventive section.

Structural elements that are equivalent in the following explanation will be assigned the same numeric symbols and redundant explanations thereof will be omitted.

FIG. **61** is a perspective view showing a channel unit **1401** in the medical treatment endoscope according to the present embodiment. Aside from a few reusable types, the channel unit **1401** undertaking cleaning or sterilization is made of a stainless steel SUS 303 to resist autoclave sterilization. SUS 304 may be used in place of SUS 303. In addition, it is preferable that at least screw engagement portions of a connecting member **1424** and a mating fixture section **1404** engaging with a first cap **1402** and a second cap **1403** respectively for maintaining a sterilized state in the channel unit **1401** be made of SUS 303 or 304. Autoclaving method in this manner readily provides preferable sterilization to the screw engagement portions.

The channel unit **1401** is formed so that the connecting member **1424** in the vicinity of the tip of a metal hardware member has the most reduced diameter while the diameter increases gradually toward the proximal end so as to provide smooth insertion into an operation stick **1430**, which will be explained later.

FIG. **62** is a cross-sectional view of the channel unit **1401**. A first piston **1405** provided to the mating fixture section **1404** and engaging with a second-bending-link-engagement section **1431** of the operation stick **1430** regulates extension and retraction of a sliding member **1436**, which will be explained later, provided to the operation stick **1430** for operating the second-bending-wire unit **1303**. A second piston **1406** for preventing removal of the procedure instrument **1305** (not shown in the drawings) inserted in a channel in the channel unit **1401** is provided in the vicinity of the base end relative to the first piston **1405**.

Most of the functions and movements of the second-bending-link-engagement section **1431** are the same as those of the erroneous-movement-preventive section **1369** according to the second embodiment. Different points will be explained later.

A freely rotatable ball **1407** provided to a tip of the second piston **1406** protruding into the channel reduces friction produced during extension and retraction of the procedure instrument **1305** in the channel. This results in reducing operator's burdensome operation, thereby enabling accurate extension and retraction of the procedure instrument **1305**. High pressure injection of cleaning liquid, etc. into a through-hole **1408** provided on the outer periphery of the mating fixture section **1404** and communicating to a space in which the second piston **1406** makes a sliding movement allows the outer periphery of the ball **1407** to be cleaned.

The aforementioned configuration using the example having the separable operation stick and the channel unit using pistons **1405** and **1406** is applicable to a configuration using the two components in one unit.

A fixture member **1410** using screw engagement for connecting and fixing the mating fixture section **1404** to a main body **1409** is attached to a tip of the mating fixture section **1404**. A plurality of groves **1410**A for facilitating removal are provided to the fixture member **1410**. A substantial U-shaped cross section of the inner surface of each grove **1410**A, orthogonal to the axial line, formed in a curved surface free from sharp edges facilitates cleaning thereof. The bearings disposed on the inner surface of the linear bush **1411** and damaged by chemicals or in sterilization processes can be replaced easily since removing the fixture member **1410** allows a linear bush **1411** attached in the mating fixture section **1404** to be taken out.

The main body **1409** connected to the mating fixture section **1404** is provided with: an outer pipe **1412** forming the outer periphery thereof; a channel pipe **1413** inserted into the outer pipe **1412**; a slide pipe **1414** attached to the base end of the channel pipe **1413**; and a spring **1415** urging the slide pipe **1414** toward the base end.

The outer pipe **1412** is a cylindrical member having the tip connected to a connecting section **1416** connected to the instrument channel and the base end connected to the mating

fixture section **1404** via the fixture member **1410**. As shown in FIG. **61**, a drain hole **1412**A provided on the outer periphery of the outer pipe **1412** provides desirable circulation and drainage of the cleaning liquid injected into the channel unit **1401**.

The channel pipe **1413** having a lumen serving as a channel which allows insertion of the procedure instrument **1305** therethrough has three pipes including a first pipe **1413**A, a second pipe **1413**B, and a third pipe **1413**C. The inner diameter of the distally provided first pipe **1413**A is greater than the outer diameter of the second pipe **1413**B connected to the base end thereof allows the second pipe **1413**B to extend into the first pipe **1413**A and allows a part of the second pipe **1413**B to be enclosed in the first pipe **1413**A. A substantial ring-shape first stopper **1417** attached to the base end of the first pipe **1413**A as shown in FIG. **63** in magnified view and making contact with a second stopper **1418** attached to the tip of the second pipe **1413**B prevents removal of the second pipe **1413**B from the first pipe **1413**A. Significant clearances obtained between the inner periphery of the base end of the first stopper **1417** and the second pipe **1413**B and between the inner periphery of the first pipe **1413**A and the outer periphery of the second stopper **1418** provide smooth extension and retraction of the second pipe **1413**B in the first pipe **1413**A. In addition, a taper tip and a taper base end of the outer periphery of the first stopper **1417** formed to have gradually reduced outer diameters prevent the spring **1415** from hooking thereinto.

A third stopper and a fourth stopper (not shown in the drawing) having the same shape as the first stopper **1417** and the second stopper **1418** and attached to the base end of the second pipe **1413**B and to the tip of the third pipe **1413**C connected respectively allow the third pipe **1413**C to extend into the second pipe **1413**B, thereby allowing a part of the third pipe **1413**C to be enclosed in the second pipe **1413**B.

The third pipe **1413**C slides in the outer pipe **1412** unitarily with the slide pipe **1414** since the base end of the third pipe **1413**C fixed to the tip of a member **1420** has a shape allowing the procedure instrument **1305** to make contact therewith; and the member **1420** using screw engagement is fixed to the slide pipe **1414**. Also, the screw engagement between the third pipe **1413**C and the slide pipe **1414** permits dissembling and cleaning of the two components separately.

The tip of the first pipe **1413**A is brazed and fixed to a mouthpiece **1419**. Visual inspection readily permits observation of a brazed portion seeping from a hole **1419**A provided to the mouthpiece **1419**.

The outer diameter of the slide pipe **1414** is set to be slightly smaller than the inner diameter of the outer pipe **1412**. The aforementioned member **1420** attached to a base end **1414**A of the slide pipe **1414** causes the procedure instrument **1305** inserted in the channel unit **1401** to push the member **1420**, thereby allowing the slide pipe **1414** and the third pipe **1413**C to move distally. A taper end surface of the tip of the slide pipe **1414** having an inner diameter increasing gradually toward the tip prevents hooking of the spring **1415** onto the slide pipe **1414** while making extending and retracting movements in the outer pipe **1412**.

The coil spring **1415** made of metal, etc., has a loop having three channel pipes **1413** inserted therethrough. The spring **1415** is inserted in the slide pipe **1414**. The base end of the spring **1415** making contact with a part having the third pipe **1413**C fixed thereto urges the slide pipe **1414** to be positioned in the mating fixture section **1404** prior to insertion of the procedure instrument **1305**.

The loop diameter of the spring **1415** is set to be smaller than the inner diameter of the slide pipe **1414** slightly and greater than the outer diameter of the channel pipe **1413** significantly so that inconcentric disposition of the spring **1415** relative to the outer pipe **1412** in the outer pipe **1412** may resist interference with the first stopper **1417**.

The connecting section **1416** is connected to the main body **1409** via a flexible tube **1421**. The outer periphery of the tube **1421** is coated by a cylindrical blade **1422** formed by weaving metal wires. The blade **1422** curbing the extension of the tube **1421** in the axial line direction prevents the tube **1421** making extension and contraction from absorbing the extension and retraction of the procedure instrument, thereby allowing the extension and retraction of the procedure instrument to be transferred to the tip of the procedure instrument reliably.

The tip of the tube **1421** is fixed to a fitting member **1423** fixed by screw engagement to the connecting member **1424** connecting to the instrument channel. Adjusting the length of screw engagement between the fitting member **1423** and the connecting member **1424** absorbs variation in length of the tube **1421** produced while assembling the channel unit **1401**, thereby facilitating manufacturing of the channel unit **1401**.

The base end of the tube **1421** is fixed to the mouthpiece **1419**. A vent valve **1425** provided between the tube **1421** and the channel pipe **1413** of the main body **1409** ensures air-tightness in an area ahead of the channel pipe **1413**. A washer **1426** presses and fixes the vent valve **1425** in the axial line direction of the channel unit **1401**. A fastening member **1427** engaging with the mouthpiece **1419** by screw engagement fixes the washer **1426** and the base end of the tube **1421** onto the vent valve **1425**. Accordingly, air-tightness can be maintained reliably since the vent valve **1425** upon undergoing screw engagement is free from a twisting force acting thereonto around the axial line.

FIG. **64** is a perspective view showing the operation stick **1430** having the channel unit **1401** inserted therethrough. A stainless steel SUJ2 or SUS 420J2 is used to improve the endurance of a pipe **1438** (see FIG. **65**) of the operation stick **1430**. It is preferable to harden the aforementioned materials to obtain 58 HRC (Rockwell Hardness C-Scale) or greater if necessary, and it is further preferable to provide anti-corrosion coating, e.g., hard chromium electroplating. This allows the first pipe **1413**A to resist damage caused by the bearing disposed on the inner periphery of the linear bush **1436**A attached to the sliding member **1436** which will be explained later.

In addition, the outer periphery of the operation stick **1430** is fully chamfered and formed not to have sharp edge sections which will tear a drape **1034** covering the operation section onto which the operation stick **1430** is attached. This configuration prevents an unsterilized section from being exposed when the medical treatment endoscope is operated.

FIG. **65** is a cross-sectional view showing the operation stick **1430** having the channel unit **1401** inserted and fixed therethrough. The outer diameter of the channel unit **1401** corresponding to the mating fixture section **1404** is substantially the same as the inner diameter of the operation stick **1430**; thus, the channel unit **1401** makes substantial close contact with the operation stick **1430**.

On the other hand, the outer pipe **1412** of the main body **1409**, the mouthpiece **1419**, and inner periphery of the operation stick **1430** defines a constant clearance G. This provides smooth insertion of the channel unit **1401** into the operation stick **1430** since the aforementioned clearance G absorbs the shift of axial lines between the main body **1409** and the mating fixture section **1404**. The force applied onto the channel unit **1401** while operating the procedure instrument **1305** is transferred to the operation stick **1430** and the operation

section mainly via the mating fixture section **1404** disposed in the vicinity of the linear bush **1411**.

The tip of a crank-shaped connecting member **1432** of the second-bending-link-engagement section **1431** is in the vicinity of a tubular main body **1433** closely. This configuration will meet fewer interference between the operation stick **1430** and the enclosure **1379** of the operation section during operation thereof since the size of the main body **1433** including the connecting member **1432** in the vertical direction can be further reduced. In addition, the crank shape of the connecting member **1432** made of stainless steel SUS 420J2 provides resistance to the bending stress.

A stopper **1435** attached to the connecting member **1432** by screw engagement protrudes toward a fixture section **1434** having the second-bending-link-engagement section **1431** provided thereon. Drawing the sliding member **1436** proximally by a predetermined length causes the tip of the stopper **1435** to make contact with the outer periphery of the fixture section **1434**, thereby preventing further proximal retraction of the sliding member **1436**. This prevents rupture, etc., of the operation member **1365** for operating the second bending part **308** caused by drawing the sliding member **1436** excessively. The protrusion of the stopper **1435** in length toward the fixture section **1434** is adjustable within a predetermined range by adjusting the screw engagement in length with the connecting member **1432**.

An attachment section **1437** for fixing the operation stick **1430** onto the enclosure **1379** of the operation section is attached to the main body **1433**. The attachment section **1437** is attached ahead the center of the operation stick **1430** in the longitudinal direction. The operation stick **1430** attached to the enclosure **1379** (not shown in the drawing) and operated by the procedure instrument **1305** (not shown in the drawing) inserted therethrough swings vertically and horizontally around the attachment section **1437** attached ahead of the tip relative to the center of the operation stick **1430** in the longitudinal direction reduces the swinging amount of the tip of operation stick **1430**, thereby preventing interference between the two operation sticks for operating the laterally disposed arm sections **302**A and **302**B.

FIG. **66** is a perspective view showing the main body **1433** of the operation stick **1430** in a magnified view. As shown in FIG. **66**, the attachment section **1437** and the fixture section **1434** are attached from the outside of the pipe **1438** constituting a main part of the main body **1433** and fixed thereon. As shown in FIG. **65**, the thickness of the tip of the pipe **1438** and the thickness of the base end of the pipe **1438** are shallow where steps **1438**A and **1438**B are provided respectively. The attachment section **1437** and the fixture section **1434** in the axial line direction of the pipe **1438** are fixed by inserting the pipe **1438** into a lumen from the tip and the base end of the pipe **1438** respectively while inserting the sliding member **1436** therebetween and making contact with the step **1438**A and **1438**B. The position of the attachment section **1437** around the axial line of the pipe **1438** and the position of the fixture section **1434** around the axial line of the pipe **1438** are maintained desirably by engaging a fixture screw **1437**A protruding into the lumen of the attachment section **1437** to a groove **1438**C provided to the tip of the pipe **1438** and by engaging a fixture screw **1434**A protruding into the lumen of the fixture section **1434** to a groove **1438**D provided to the base end of the pipe **1438** as shown in FIG. **66**. The attachment section **1437** and the fixture section **1434** positioned in the axial line direction around the axial line of the pipe **1438** are fixed by: a tip member **1439**A engaged with the tip of the pipe **1438** by screw engagement; a spacer **1439**B pushed by the tip member **1439**A; and a fitting member **1440** engaged with the base end of the pipe **1438** by screw engagement. This structure allows the attachment section **1437** and the fixture section **1434** to be fixed at constant positions around the axial line of the pipe **1438**. In addition, the attachment section **1437** and the fixture section **1434** can be fixed to the pipe **1438** reliably by screw engagement while the operation member **1365** is reliably attached to the operation stick **1430**.

As shown in FIG. **66**, a silencing member **1441** made of collision-absorbing material, for example, rubber, etc. is attached in the vicinity of the base end of the attachment section **1437**. The silencing member **1441** urged toward the base end by a plunger **1442** having substantial the same structure as that of the urging section **1368** provided to the fixture section **1434** upon making contact with the sliding member **1436** absorbs collision and prevents large sound when the second bending part **308** of the arm section is restored to a linear state and when the sliding member **1436** is extended. It should be noted that a certain extent of silencing effect can be obtained by providing one of the silencing member **1441** and the plunger **1442**.

As shown in FIG. **65**, a ball bearing **1445** is attached to the tip of the tip member **1439**A for fixing the spacer **1439**B. A flange section **1443** is formed by a cap **1446** attached around the outer periphery of the ball bearing **1445**. It is preferable that an outer periphery **1446**A around the axial line of the cap **1446** is formed spherical, and it is further preferable that the outer periphery **1446**A is formed on the central axis of the cap **1446** so that a sphere substantially coincides with a surface of a virtual ball having the center corresponding to a point in the middle in the axial line direction. This prevents play during operation since operating the operation stick **1430** in any direction causes the outer periphery **1446**A to make point-contact with the enclosure **1379** in the operation section as shown in FIG. **67**.

Pressing a first protrusion **1405**A and a second protrusion **1406**A substantially simultaneously cause the piston **1405** and **1406** to activate simultaneously since the first protrusion **1405**A protruding from the first piston **1405** is disposed above the second protrusion **1406**A protruding from the second piston **1406** in the channel unit **1401** according to the present embodiment, and since a step **1447**A is provided to a U-shaped hardware **1447** connected to a removal button **1444** provided to the fixture section **1434** of the operation stick **1430**.

It should be noted that adjusting the shape of the step **1447**A so that the first protrusion **1405**A can be pressed slightly faster than the second protrusion **1406**A causes the first piston **1405** to be pushed and causes the sliding member **1436** to extend distally at first, thereby dispose the second bending part **308** of the arm section in linear state. The second piston **1406** pushed subsequently provides removable state to the procedure instrument **1305**, thereby facilitating removal of the procedure instrument.

The second piston **1406** according to the present embodiment prevents falloff of the procedure instrument **1305** inserted in the channel unit **1401** in the medical treatment endoscope similarly to the aforementioned second embodiment. In addition, the sliding member **1436** for operating the second bending part **308** of the arm section can be engaged to the second-bending-link-engagement section **1431** reliably and supported there. In addition, the connecting member **1432** of the second-bending-link-engagement section **1431** engaging with an engagement piston closer to the tip to support the sliding member **1436** reduces distal protrusion of the connecting member **1432**. This results in providing the more compact operation stick **1430** and facilitating the operation thereof.

It should be noted that the aforementioned preferred embodiments of the present invention do not limit the present invention. The configuration of the present invention allows for additions, omissions, substitutions and further replacements without departing from the spirit and scope of the present invention.

For example, the aforementioned embodiment explaining that the operation member **1365** for operating the second bending part **308** of the arm section is attached to the sliding member **1436** may be replaced by a configuration in which an end section of the operation member **1365** is fixed to an end section of a rotatable lever attached to the operation stick. Rotating this case of lever allows the second bending section to be operated.

Furthermore, it should be noted that the present invention is limited by the scope of claims attached hereto, and not by the aforementioned explanations.

What is claimed is:

1. A medical apparatus comprising:

a flexible sheath;

a procedure instrument having a treatment section provided at a distal end of the procedure instrument;

an arm section having a first bending part capable of a bending operation and a first channel capable of inserting the treatment section therethrough and capable of protruding therefrom, the arm section being disposed to protrude from a tip of the sheath;

an operation stick having a second channel connected to the first channel and inserting the procedure instrument therethrough, and a bending operating part connected to the arm section by an operation-transmission member; and

an operation part provided in a proximal end side of the procedure instrument for operating the treatment section, wherein

the procedure instrument is configured to be capable of moving between a place in which the treatment section is protruded from the arm section and a predetermined place in the arm section where a whole length of the treatment section is housed inside the arm section when the procedure instrument is inserted into the operation stick, wherein

the operation stick further comprises:

a falloff-preventive section for preventing the operation part of the procedure instrument from falling off the operation stick, the falloff-preventive section is arranged at a proximal end side of the operation stick and is configured to lock and stop movement of the operation part of the procedure instrument within the operation stick when the treatment section is disposed at the predetermined place in the arm section,

the first bending part of the arm section is bent by tilting the operation stick in at least one of vertical and horizontal directions,

wherein the falloff-preventive section comprises a piston enclosed within the operation stick.

2. The medical apparatus according to claim **1**, wherein the falloff-preventive section is provided in a vicinity of a base end side of the operation stick relative to a regulation section configured to regulate movement of the bending operating part.

3. The medical apparatus according to claim **1**, wherein the second channel formed by a plurality of pipes is capable of extending and contracting in the operation stick, and a base end of the second channel has a shape capable of making contact with a part of the procedure instrument, and the second channel is contracted by moving the procedure instrument inserted in the second channel toward a tip of the operation stick.

4. The medical apparatus according to claim **1**, wherein when the procedure instrument is inserted in the second channel, a regulation section configured to regulate movement of the bending operating part is moved by the procedure instrument, and regulation to the bending operating part is released to enable operation of the first bending part.

5. The medical apparatus according to claim **1**, wherein the bending operating part is a slider capable of sliding and attached to a main body of the operation stick.

6. The medical apparatus according to claim **1**, wherein the bending operating part is a lever attached to a main body of the operation stick.

7. The medical apparatus according to claim **1**, wherein the falloff-preventive section is formed to be capable of engaging with an engagement section provided on an outer periphery of the procedure instrument.

8. The medical apparatus according to claim **1**, further comprising an observation section, attached to the sheath for observing an observation object.

9. The medical apparatus according to claim **1**, wherein the arm section has a second bending part capable of a bending operation, the second bending part being disposed at further toward a proximal side of the arm section than the first bending part.

10. A medical apparatus comprising:

a flexible sheath;

a procedure instrument having a treatment section provided at a distal end of the procedure instrument;

an arm section having a first bending part capable of a bending operation and a first channel capable of inserting the treatment section therethrough and capable of protruding therefrom, the arm section being disposed to protrude from a tip of the sheath;

an operation stick having a bending operating part connected to the arm section by an operation-transmission member; and

a channel unit inserted into the operation stick detachably and having a second channel connected to the first channel and inserting the procedure instrument therethrough; and

an operation part provided in a proximal end side of the procedure instrument for operating the treatment section; wherein

the procedure instrument is configured to be capable of moving between a place in which the treatment section is protruded from the arm section and a predetermined place in the arm section where a whole length of the treatment section is housed inside the arm section when the procedure instrument is inserted into the operation stick, wherein

the channel unit further comprises:

a falloff-preventive section for preventing the operation part of the procedure instrument from falling off the channel unit, the falloff-preventive section is arranged at a proximal end side of the channel unit and is configured to lock and stop movement of the operation part of the procedure instrument within the channel unit to when the treatment section is disposed at the predetermined place in the arm section,

the first bending part of the arm section is bent by tilting the operation stick in at least one of vertical and horizontal directions,

wherein the falloff-preventive section comprises a piston enclosed within the operation stick.

11. The medical apparatus according to claim **10**, wherein the falloff-preventive section is provided in a vicinity of a base end side of the channel unit relative to a regulation section configured to regulate movement of the bending operating part.

12. The medical apparatus according to claim **10**, wherein the second channel formed by a plurality of pipes is capable of extending and contracting in the channel unit, and a base end of the second channel has a shape capable of making contact with a part of the procedure instrument, and the second channel is contracted by moving the procedure instrument inserted in the second channel toward a tip of the channel unit.

13. The medical apparatus according to claim **10**, wherein when the procedure instrument is inserted in the second channel, a regulation section configured to regulate movement of the bending operating part is moved by the procedure instrument, and regulation to the bending operating part is released to enable operation of the first bending part.

14. The medical apparatus according to claim **10**, wherein the bending operating part is a slider capable of sliding and attached to a main body of the operation stick.

15. The medical apparatus according to claim **10**, wherein the bending operating part is a lever attached to a main body of the operation stick.

16. The medical apparatus according to claim **10**, wherein the falloff-preventive section is formed to be capable of engaging with an engagement section provided on an outer periphery of the procedure instrument.

17. The medical apparatus according to claim **10**, further comprising an observation section, attached to the sheath for observing an observation object.

18. The medical apparatus according to claim **10**, wherein the arm section has a second bending part capable of a bending operation, the second bending part being disposed at further toward a proximal side of the arm section than the first bending part.

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